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SALT LAKE CITY STREAMS, UTAH

LITTLE DELL LAKE

FOUNDATION REPORT

APRIL 1995

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

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TABLE OF CONTENTS

PERTINENT DATA

CONSTRUCTION CHRONOLOGY

1. INTRODUCTION 1

1.1 Purpose and Scope 1
1.2 Authorization 1
1.3 Location and Purpose of Project 1
1.4 Description of Project 2
1.4.1 Dam 2
1.4.2 Spillway 3
1.4.3 Outlet Works 3
1.4.4 Parley's Creek Diversion 3
1.5 Project History 4
1.6 Contract Administration 4
1.7 Contracts 5

2. REGIONAL GEOLOGY AND SEISMICITY 8

2.1 Regional Geology 8
2.2 Seismicity 9
2.2.1 Maximum Earthquake 10
2.2.2 Operational Earthquake 10

3. SITE GEOLOGY 11

3.1 General 11
3.2 Physical Setting 11
3.3 Geologic Units 11
3.3.1 Bedrock 11
3.3.2 Older Alluvium 11
3.3.3 Younger Alluvium 11
3.3.4 Slopewash 12
3.3.5 Alluvial Fans 12

3.3.6 Nugget Sandstone 12
3.4 Geologic Structure 12
3.5 Landslides 13
3.6 Geology of Project Features 13
3.6.1 Dam Foundation 13
3.6.2 Outlet Works 13
3.6.3 Spillway 14
3.6.4 Parley's Creek Diversion Structure 14
3.6.5 Reservoir Borrow Area 14

4. FOUNDATION EXPLORATIONS 15

4.1 Explorations Performed Before Construction 15
4.2 Explorations Performed During Construction 20

5. FOUNDATION CONDITIONS, TREATMENT, AND APPROVAL 21

5.1 General 21
5.1.1 Geologic Mapping 21
5.1.2 Foundation Approval 21
5.2 Dam Foundation 22
5.2.1 Core Trench 22
5.2.1.1 Excavation 22
5.2.1.2 Foundation Materials 24
5.2.1.3 Groundwater and Dewatering 27
5.2.1.4 Foundation Preparation and Treatment 29
5.2.2 Upstream and Downstream Embankment Shell Foundations 31
5.2.2.1 Excavation 31
5.2.2.2 Foundation Materials 33
5.2.2.3 Foundation Treatment 36
5.2.2.4 Groundwater, Dewatering, and Diversion of Dell Creek . . . 36
5.3 Outlet Works 37
5.3.1 Description of Outlet Works 37
5.3.2 Upstream Portal and Intake Structure 38
5.3.2.1 Upstream Portal 38
5.3.2.2 Intake Structure and Cut-and-Cover Conduit 39
5.3.3 Tunnel - Excavation, Support, and Geologic Conditions Encountered 40
5.3.3.1 Excavation and Support 40
5.3.3.2 Geologic Conditions Encountered 41
5.3.4 Downstream Portal, Downstream Operational Control Structure (DOCS), Wing Walls, Plunge Pool, and Discharge Channel Sill 44
5.3.4.1 Downstream Portal 44

5.3.4.2 Downstream Operational Control Structure (DOCS) 45
5.3.4.3 Wing Walls 45
5.3.4.4 Plunge Pool 46
5.3.4.5 Discharge Channel Sill 46
5.4 Spillway 46
5.5 Parley's Creek Diversion Structure 47

6. GROUTING 48

6.1 Foundation Grout Curtain 48
6.1.1 General 48
6.1.1.1 Sub-contractor 50
6.1.1.2 Deep Nipples versus Grout Cap 50
6.1.1.3 Equipment, Materials and Techniques 50
6.1.2 Relationships Between Grout Takes, Geology, and Foundation Areas 53
6.2 Tunnel Grouting 54
6.2.1 General 54
6.2.1.1 Sub-contractor 55
6.2.1.2 Nipples 55
6.2.1.3 Equipment, Materials and Techniques 55
6.2.1.4 Grouting of Gravel Under the Tunnel Invert 57
6.2.2 Grouting Results 57
6.2.2.1 Discussion of Grouting Results at Specific Locations 57

7. INSTRUMENTATION 59

7.1 Embankment Foundation Instrumentation 59
7.2 Portal Instrumentation 59
7.3 Tunnel Instrumentation 60
7.4 Reservoir Rim Instrumentation (Survey Points) 60

8. RECOMMENDATIONS AND CONSIDERATIONS 61

8.1 General 61
8.2 Drawings and Specifications, General 61
8.3 Foundation 62

9. REFERENCES 63

TABLES

1 Summary of Excavation Quantities 24
2 General Summary of Foundation Grouting 50

3 Average Grout Takes 51
4 General Summary of Drilling and Grouting in Tunnel 56
5 Embankment Foundation Instrumentation 60
6 Detailed Summary of Foundation Grouting . . . . Follows Fdn. Report
7 Detailed Summary of Drilling and Grouting in Tunnel Follows Fdn. Report

APPENDIX 1

APPENDIX 2

FIGURES

1 Typical Blast Hole Pattern - Upstream Tunnel
2 Typical Blast Hole Pattern - Downstream Tunnel

LIST OF PLATES

Number	Title
1	General Location Map
2	Project Plan
3	Embankment Plan - End of Construction 1992
4	Embankment Plan
5	Plan - Intake Structure and Cut-and-Cover Conduit
6	Plan - Downstream Operational Control Structure, Wingwalls and Plunge Pool
7	Plan and Section of Spillway
8	Plan of Parley's Creek Diversion Structure
9	Regional Geology - Description of Map Units
10	Regional Geology
11	Geologic Map - Legend and Symbols
12	Geologic Map Embankment Foundation
13	Geologic Map - Impervious Zone, Sta. 10+40 to Sta. 16+25
14	Geologic Map - Impervious Zone, Sta. 16+25 to Sta. 22+25
15	Geologic Map - Impervious Zone, Sta. 22+25 to Sta. 27+87
16	Geologic Section Along Axis of Dam, Sta. 10+15 to Sta. 16+10
17	Geologic Section Along Axis of Dam, Sta. 16+10 to Sta. 21+75
18	Geologic Section Along Axis of Dam, Sta. 21+75 to Sta. 27+75
19	Geologic Sections Parallel to Axis of Dam, at 275' D/S and at 150' U/S
20	Geologic Sections Perpendicular to Axis, at Sta. 13+00 and Sta. 18+00
21	Contour Map - Embankment Foundation
22	Foundation Approval Map - Embankment Foundation

23	Foundation Approval Detail Maps, Sta. 10+80 to Sta. 12+95 and Sta. 24+87 to Sta. 27+10
24	Foundation Approval Map - Spillway
25	Foundation Approval Map - Intake Structure Area
26	Foundation Approval Map - DOCS Area
27	Foundation Approval Map - Parley's Creek Diversion Structure
28	Geologic Map of Intake Structure and Cut-and-Cover Conduit
29	Geologic Map and Sections - Upstream Portal
30	Flood Control Tunnel Geologic Map - Sta. 10+40 to Sta. 11+78
31	Flood Control Tunnel Geologic Map - Sta. 11+78 to Sta. 12+98.35
32	Flood Control Tunnel Geologic Map - Sta. 12+98.35 to Sta. 14+28
33	Emergency Control Chamber Geologic Map - Sta. 13+62 to Sta. 14+32
34	Flood Control Tunnel Geologic Map - Sta. 14+28 to Sta. 15+45
35	Flood Control Tunnel Geologic Map - Sta. 15+45 to Sta. 16+65
36	Flood Control Tunnel Geologic Map - Sta. 15+65 to Sta. 17+97.64
37	Flood Control Tunnel Geologic Map - Sta. 17+97.64 to Sta. 19+26
38	Flood Control Tunnel Geologic Map - Sta. 19+26 to Sta. 20+55
39	Flood Control Tunnel Geologic Map - Sta. 20+55 to Sta. 21+75
40	Flood Control Tunnel Geologic Map - Sta. 21+75 to Sta. 22+85
41	Flood Control Tunnel Geologic Map - Sta. 22+85 to Sta. 24+06
42	Flood Control Tunnel Geologic Map - Sta. 24+06 to Sta. 25+20
43	Flood Control Tunnel Geologic Map - Sta. 25+20 to Sta. 26+32
44	Geologic Map - Downstream Portal
45	Geologic Map of DOCS, Wingwalls and Plunge Pool
46	Spillway Geologic Map - Profile, Excavation and Sill
47	Geologic Map of Control Sill
48	Spillway Erosion Control Structures A and B
49	Spillway Erosion Control Structures C, D and E
50	Geologic Map of Parley's Creek Diversion Structure
51	Foundation Grout Curtain - Holes A1050-A1400 Excluding Quaternary Holes
52	Foundation Grout Curtain - Holes A1050-A1400 Quaternary Holes
53	Foundation Grout Curtain - Holes B1050-B1400
54	Foundation Grout Curtain - Holes C1050-C1400 Excluding Quaternary Holes
55	Foundation Grout Curtain - Holes C1050-C1400 Quaternary Holes
56	Foundation Grout Curtain - Holes A1400-A1750 Excluding Quaternary Holes

57 Foundation Grout Curtain - Holes A1400-A1427 Quaternary Holes
58 Foundation Grout Curtain - Holes B1400-B1750
59 Foundation Grout Curtain - Holes C1400-C1750 Excluding Quaternary Holes
60 Foundation Grout Curtain - Holes C1400-C1750 Quaternary Holes
61 Foundation Grout Curtain - Holes A1750-A2100
62 Foundation Grout Curtain - Holes B1750-B2100
63 Foundation Grout Curtain - Holes C1750-C2100
64 Foundation Grout Curtain - Holes A2100-A2450
65 Foundation Grout Curtain - Holes B2100-B2450
66 Foundation Grout Curtain - Holes C2100-C2450
67 Foundation Grout Curtain - Holes A2450-A2817
68 Foundation Grout Curtain - Holes B2450-B2817
69 Foundation Grout Curtain - Holes C2450-C2817
70 Foundation Grout Curtain - Grout Take Versus Station - Station 10+30 to 12+30
71 Foundation Grout Curtain - Grout Take Versus Station - Station 10+30 to 10+50 Additional Line
72 Foundation Grout Curtain - Grout Take Versus Station - Station 12+31 to 14+30
73 Foundation Grout Curtain - Grout Take Versus Station - Station 14+31 to 16+30
74 Foundation Grout Curtain - Grout Take Versus Station - Station 14+31 to 16+30 Additional Line
75 Foundation Grout Curtain - Grout Take Versus Station - Station 16+31 to 18+30
76 Foundation Grout Curtain - Grout Take Versus Station - Station 16+31 to 18+30 Additional Holes
77 Foundation Grout Curtain - Grout Take Versus Station - Station 18+31 to 20+30
78 Foundation Grout Curtain - Grout Take Versus Station - Station 20+31 to 22+30
79 Foundation Grout Curtain - Grout Take Versus Station - Station 20+31 to 22+30 Additional Line
80 Foundation Grout Curtain - Grout Take Versus Station - Station 22+31 to 24+30
81 Foundation Grout Curtain - Grout Take Versus Station - Station 24+31 to 26+30
82 Foundation Grout Curtain - Grout Take Versus Station - Station 26+31 to 28+17
83 Core Trench Grouting - Sta. 10+50 to Sta. 13+10
84 Core Trench Grouting - Sta. 13+10 to Sta. 15+60
85 Core Trench Grouting - Sta. 15+60 to Sta. 18+05
86 Core Trench Grouting - Sta. 18+05 to Sta. 20+50

87 Core Trench Grouting - Sta. 20+50 to Sta. 22+85
88 Core Trench Grouting - Sta. 22+85 to Sta. 25+30
89 Core Trench Grouting - Sta. 25+30 to Sta. 27+60
90 Core Trench Grouting - Sta. 27+60 to Sta. 28+75
91 Core Trench Foundation Treatment Map - Sta. 27+85 to Sta. 22+00
92 Core Trench Foundation Treatment Map - Sta. 22+00 to Sta. 16+00
93 Core Trench Foundation Treatment Map - Sta. 16+00 to Sta. 10+40
94 Outlet Works Tunnel Contact Grouting - Sta. 10+40 to Sta. 11+60
95 Outlet Works Tunnel Contact Grouting - Sta. 11+60 to Sta. 13+60
96 Outlet Works Tunnel Contact Grouting - Sta. 13+60 to Sta. 14+30
97 Outlet Works Tunnel Contact Grouting - Sta. 14+30 to Sta. 16+70
98 Outlet Works Tunnel Contact Grouting - Sta. 16+70 to Sta. 19+03
99 Outlet Works Tunnel Contact Grouting - Sta. 19+03 to Sta. 21+35
100 Outlet Works Tunnel Contact Grouting - Sta. 21+35 to Sta. 23+70
101 Outlet Works Tunnel Contact Grouting - Sta. 23+70 to Sta. 24+50
102 Outlet Works Consolidation Grouting - Sta. 10+47 to Sta. 11+60
103 Outlet Works Consolidation Grouting - Sta. 11+60 to Sta. 13+60
104 Outlet Works Consolidation Grouting - Sta. 13+60 to Sta. 14+30
105 Tunnel Consolidation Grouting - Sta. 14+30 to Sta. 15+64
106 Tunnel Consolidation Grouting - Sta. 15+64 to Sta. 18+00
107 Tunnel Consolidation Grouting - Sta. 18+00 to Sta. 19+50
108 Location of Explorations - Embankment Foundation
109 Log of Cored Drill Hole 1F-102
110 Logs of Cored Drill Holes 1F-103 and 1F-104
111 Log of Cored Drill Hole 1F-105

PHOTOGRAPHS

1 Aerial photo of damsite on 6/30/89
2 Aerial photo of damsite on 11/1/89
3 Aerial photo of damsite on 5/2/90
4 Aerial photo of damsite on 10/17/90
5 Aerial photo of damsite on 5/16/91
6 Aerial photo of damsite on 11/11/91
7 Aerial photo of damsite on 5/14/92
8 Aerial photo of damsite on 11/11/92
CT1 (CORE TRENCH 1) Contractor attempted to perform preliminary cleanup of core trench on this date, 2/14/90, but abandoned the effort. Photo looks south at the orange backhoe near dam axis, Sta. 15+00.

CT2 Looking upstream as Contractor works on preliminary cleanup near Sta. 14+20. 3/22/90

CT3 Looking downstream and left at preliminary cleanup at base of left abutment, near Station 14+00.

CT4 Core trench near Sta. 15+00. Crew cleaning soft material from fractures before placing mortar and dental concrete.

CT5 Looking left near Sta. 15+00 in core trench at joints that have been mortared. The white color result from curing compound which was initially applied to the surface of the mortar. This practice was later discontinued.

CT6 Grout filling in fracture near foundation grout curtain in core trench.

CT7 Looking down and downstream at dental excavation used as dewatering sump at the base of the left abutment (near Station 14+00) near the downstream edge of the impervious fill foundation.

CT8 Looking left and down into sump described above. The bags contain dry cement. Dental concrete was placed around the PVC. When the fill exceeded the head in the sump the PVC and gravel were grouted.

CT9 Looking downstream at base of left abutment at area upstream of grout curtain prepared for dental/leveling concrete.

CT10 Same area as previous photo. Note sand bags used to form edges to prevent "feathered" edges.

CT11 Looking downstream at cleanup of core trench, preparing to place leveling concrete. Backhoe bucket is at about Sta. 15+40, 5 feet upstream of the dam axis.

CT12 Same area as previous photo taken from further away. Grout nipples are in deepest area seen in the previous photo. Photo covers the core trench invert from Sta. 14+60 to 15+50.

CT13 Looking downstream at the core trench foundation and leveling concrete on 9/18/90. Sta. 16+00 is in the middle of the photo. Refer also to the foundation treatment map.

CT14 Looking downstream at the core trench foundation. Sta. 15+50 is in the middle of the photo.

CT15 Looking downstream at the core trench foundation. Sta. 15+00 is in the middle of the photo.

CT16 Looking downstream at the core trench foundation. Sta. 14+50 is in the middle of the photo.

CT17 Looking east at the core trench from the top of the downstream cut-slope near Sta. 17+00.

CT18 Looking right from about Sta. 13+80. Contractor's crew is using a high pressure air nozzle to remove loose material from the core trench foundation at about Sta. 14+75 before beginning the first impervious fill placement.

CT19 The first impervious fill placement at about Sta. 15+50 to 16+00.

CT20 Looking left at the core trench foundation between Sta. 12+00 and 13+00, before final cleanup. Note overhangs resulting from rock breaking along bedding planes in hard sandstone layers. Corps of Engineers geologist is in the center of the photo.

CT21 Looking left at the left abutment core trench foundation at the toe of the upstream cut-slope. Inspecting cleanup in preparation for placing concrete fillet to correct an overhang.

CT22 Same area as the previous photo, after placing the fillet.

CT23 Looking downstream at the placement of a concrete fillet at the left abutment core trench. Note form on near end to prevent thinning (feathering out) at the ends of the fillets.

CT24 Looking left at the same area as the previous photo. Crew is working on mortaring joints marked with green paint.

CT25 Looking left at the left abutment core trench. Area 092892A (see the Foundation Approval Map) approved below the horizontal orange lines. Green paint marks numerous fractures in hard blocky sandstone which require mortaring before placing fill.

CT26 Fine fractures in a siltstone bed marked for mortar.

CT27 Same description as previous photo.

CT28 Large open fractures in 2-foot-thick hard sandstone bed, after mortaring fractures. Left abutment core trench, Sta. 11+10 at toe of upstream cut-slope.

CT29 More distant view of the area in the previous photo.

CT30 Looking downstream near Sta. 18+00 in the core trench. Crew completes final preparation of foundation in an area where little or no joint mortaring was required (see also the Foundation Treatment Map). The Mesco front-end-loader is performing wheel rolling of impervious fill against a previously approved area to the left.

CT31 Looking upstream from the grout curtain (15 feet upstream of the dam axis) at an area near Sta. 21+60. Gray stringers are grout filled fractures. Excessive pressure was apparently used at this location, resulting in some lifting of the foundation. The fractures were filled with dense grout and no harmful effects resulted. This photo shows an area typical of the conditions where the soft rock was intensely fractured but the fractures were tight and no joint mortaring was required.

CT32 Looking upstream at area of core trench foundation near the toe of the upstream cut-slope near Sta. 22+05. Crew is spreading dry cement on area of numerous small seeps immediately before placing impervious fill.

CT33 Excavation for sump 38 feet upstream of the dam axis at Sta. 23+40. Looking upstream and left from Sta. 23+50 on the dam axis.

CT34 Looking left from about Sta. 23+60. Howie Aubertin, Corps of Engineers Assistant Resident Engineer, with rock hammer pointing to substantial flow from a spring which flows down to the sump below. A worker is using hand operated equipment to compact the gravel in the sump.

CT35 Looking upstream along Sta. 23+50 at sump. Note 24-inch-diameter CMP and two 4-inch-diameter PVC pipes; also note the gravel collector extending up to the spring shown in the previous photo.

CT36 Area below the feet of the workers where a limited amount of slush grout was utilized. Area extends upstream from the dam axis at Sta. 23+50.

CT37 Area in previous photo after placing slush grout over an area of about 4 feet by 10 feet.

CT38 Looking upstream at excavation of anomalous soft zones within hard sandstone bed crossing the dam axis between Sta. 20+05 and 20+15.

CT39 Same area as the previous photo after placing dental concrete in the holes left after excavating the soft material.

CT40, 41 and 42 Anomalous soft zone in hard blocky sandstone layer at the downstream edge of the impervious core foundation near Sta. 20+70. The soft material was hand excavated and replaced with concrete.

CT43 Looking right at Sta. 25+90 in the core trench. Note numerous joints mortared in this softer rock area.

CT44 Looking right at Sta. 26+95 in the core trench. Photo is typical of soft rock areas where moderate amounts of joint mortaring were required in softer rock areas.

CT45 Looking upstream from the top of the downstream cut-slope at the Station 22 Fault Zone.

CT46 Looking downstream from the top of the downstream cut-slope at the Station 22 Fault Zone.

CT47 Looking upstream at the Station 22 Fault in the upstream cut-slope where the fault is covered by the Upper Gravel Layer of the Older Alluvium. The fault does not disturb the Older Alluvium.

CT48 Close-up view of the fault where it is covered by Older Alluvium. The fault ends at the bottom of the alluvium in the center of the picture.

EMB1 (EMBANKMENT FOUNDATION 1) View of the right abutment from the left abutment before beginning excavation of the core trench.

EMB2	The right abutment in the summer of 1988 after beginning excavation of the core trench.
EMB3	The right abutment after stripping was completed in 1989.
EMB4	View of the left abutment after beginning the core trench excavation in 1988.
EMB5	The left abutment on 10/23/89. The abutment has been stripped and excavation of the overburden at the downstream shell foundation is in progress.
EMB6	Looking left (northeast to southeast) at the portion of the upstream shell foundation approved as "Area G" (5-30-90). Excavation and proof-rolling has been completed in this area on which the maximum section of the dam will be founded.
EMB7	Looking south at the portion of the upstream shell foundation approved as " Area X" (9-4-90). Rockier Random II fill was requested for this area where the foundation consisted of the weakest materials within the dam foundation.
EMB8	Looking right at the upstream portion of the downstream shell foundation approved as "Area AB" (5-4-90).
EMB9	Looking upstream at the portion of the downstream shell foundation approved as "Area 051691A".
EMB10	Looking downstream along the downstream right abutment as Transition 1 is placed on the area approved as "Area 051792b"
EMB11	Looking downstream along the downstream left abutment as Transition 1 is placed on approved foundation.
T1	(TUNNEL 1) Downstream portal of outlet works tunnel before blasting the first round. Blasting mat made of old tires was used to reduce "fly rock".
T2	Same area as previous photo, after blasting first round.
T3	Looking upstream at area mapped as face no. 97 at Sta. 25+98. Two-boom jumbo is drilling blast holes at heading.
T4	Dark areas are water seeping up from the invert near Sta. 22+98.
T5	Looking upstream at area mapped as face no. 70 at Sta. 21+96. Montmorillonitic clay layer did not fragment properly when blasted causing damage to several sets already in place.
T6	Damaged sets at area described in previous photo.
T7	Damaged sets after being removed from tunnel.
T8	Pattern of blast holes drilled in heading.
T9	Using a jackleg drill to install a tunnel strap in the crown of the excavation at Sta. 11+70.
T10	Looking upstream in the downstream adit. Tunnel sets, blocking and shotcrete were used as initial support. Shotcrete ends in the near view.

T11 Wood blocking constructed in "log cabin" type configuration to allow concrete to flow around and between timbers.

T12 Looking upstream and to the left (southeast) side of the tunnel at the Set 263 Fault. Farthest set is set 262 at about Sta. 18+58. Note extensive wood blocking.

T13 Same area as previous photo. Looking lower and more toward the side of the tunnel. Yellow material is fault gouge and breccia.

T14 Same area as previous photo, after applying shotcrete. Last set on left is No. 261.

T15 Same area as previous photos. Looking more directly at lower part of left side of tunnel. Yellow material at bottom of sets is fault gouge. Water flowing from fault was visually estimated at greater than 20 gpm.

T16 Looking upstream at the Set 263 Fault in heading at about Sta. 18+32. Yellow-brown clay gouge and breccia slope across the left side of the photo.

T17 Looking upstream at the north side of the tunnel near Sta. 17+95. Note spilling installed to pre-support the brecciated zone.

T18 Looking upstream at the heading mapped at Sta. 17+89.

T19 Looking upstream in the ECC at the two-boom jumbo drilling an anchor hole in row no. 9 in the downstream half of the ECC. The jumbo is sitting in the pilot excavation not yet excavated to the full dimensions of the ECC. Dark squares are anchor plates. Note bedding in crown is subparallel to the tunnel alignment.

T20 Looking upstream at the scissor-lift and jumbo being used to install an anchor bolt in the ECC.

T21 Looking right (northwest) at the anchor being installed.

T22 Looking upstream at wood form in upstream half of the ECC after placing the concrete lining in the downstream half.

T23 Steel slip-form in place, ready to place concrete lining in a portion of the adit.

T24 Example of where invert was seriously degraded. Note extensive wood blocking under the base of some sets. This resulted when muck was removed in preparation for placing the invert slab.

T25 Crew drilling grout holes in adit.

T26 Grouting in progress in upstream tunnel.

GC1 (GROUT CURTAIN 1) Overall curtain grouting operation viewed from the top of the left abutment.

GC2 Overall curtain grouting operation viewed from the top of the right abutment.

GC3 View from the right abutment during the winter of 1989. Grouting continued through the winter except for several days

when temperature was lower than 20 degrees below zero Fahrenheit.

GC4 Looking up from the base of the left abutment at the grouting operation.

GC5 Inspecting the foundation grouting. Looking left at about Sta. 21+00.

GC6 Inspecting the foundation grouting. Looking right at about Sta. 16+30.

GF1 (GEOLOGIC FEATURE 1) Left Abutment Fault as seen in a trench logged as 4F-20. The fault is at Station 12+72.5, 150 feet upstream of the dam axis. (See Plates 12 and 19)

GF2 View of the upper part of the south wall of fault trench FT-3. Gray sheared bedrock overhangs Older Alluvium.

GF3 Shear logged in 4F-19.

P1 (PORTALS 1) View of the upstream portal area before beginning the excavation. Photo taken from Highway 65 with telephoto lens.

P2 Upstream portal shortly after beginning the excavation.

P3 Upstream portal on 2/14/90.

P4 Upstream portal area after completion.

P5 Looking downstream and left at the downstream portal, before clearing and excavating a bench for installation of the first two inclinometers.

P6 Downstream portal on 10/5/89.

P7 Downstream portal on 11/19/89.

P8 Downstream portal after completion of excavation and support, and before construction of the DOCS.

P9 Hitachi trackhoe excavating a bench at the downstream portal.

P10 Craelius rotary drill- drilling an anchor hole near the bottom of a cut-slope at the downstream portal.

P11 Craelius rotary drill- drilling an anchor hole high on the vertical cut at the downstream portal.

P12 Downstream Portal. Crew using an air line to clean anchor holes before installing anchors bars and cement. Anchors bars can be seen in foreground.

P13 Taping centralizers to anchors bars before installing them.

P14 Downstream Portal. Installing 2-inch-diameter, slotted PVC for draining the slope. Numerous anchors have been installed in the cut-slope. The bars and the PVC tubes through which the grout was injected are visible.

P15 Performing a pull-out test on an anchor installed at the downstream portal.

P16 Applying shotcrete to vertical cut at upstream portal.

P17 Failure of vertical face at downstream portal excavation. Cut failed in a weak, altered bed when a 14+ feet high increment was excavated without support.

D1 (DOCS 1) View of the downstream Outlet Works area, looking southeast, as a round is blasted to excavate hard rock in the bottom of the Plunge Pool.

D2 Looking south at the foundation for the downstream half of the DOCS. The foundation consists of firm bedrock of the Kelvin Formation.

D3 Looking south at rock anchors and wood cribbing being installed to support the unstable slope adjacent to the downstream wingwall foundations.

D4 Looking south at the foundation for the north wingwall at the DOCS.

S1 (SPILLWAY 1) Looking right at the foundation for the right half of the spillway sill, from the spillway centerline.

S2 Looking right at the foundation for the left half of the spillway sill, from the top of the left cut-slope .

S3 Looking left at the foundation for the oversize stone downstream of the right half of the spillway.

S4 Looking left at the foundation for the oversize stone downstream of the left half of the spillway.

S5 Looking right at the foundation for the rip rap on the upstream right cut-slope of the spillway.

S6 Looking left at the foundation for the rip rap on the upstream left cut-slope of the spillway.

S7 Looking at the right cut-slope, downstream of the spillway sill.

S8 Looking at the left cut-slope, downstream of the spillway sill.

PC1 (PARLEY'S CREEK DIVERSION STRUCTURE 1) Looking downstream from the upstream end of the Diversion Structure foundation. The Hitachi trackhoe is doing final excavation before placing fill at the spillway. The right half of the foundation requires additional excavation.

PC2 Foundation of the downstream right half of the structure continued to deteriorate until all the alluvium was removed, in part because the Contractor could not control groundwater.

PC3 All the loose material was excavated from the area in the previous photo and firm bedrock of the Kelvin Formation was exposed.

PC4 After overexcavating to remove the soft, saturated alluvium, the foundation was brought back up to grade with angular gravel and cobbles.

PC5 The foundation at the downstream right corner of the diversion structure as approved.

E1 (EQUIPMENT 1) Dozer, track hoe, front end loader and dump truck excavating at the upper right abutment during the core trench contract.

E2	D-8 dozer attempting to rip hard rock on left abutment.
E3	D-8 dozer ripping soft rock on left abutment.
E4	Cat D-8 dozer and Cat 235 backhoe working together at left abutment. Trackhoe casts material to edge of bench after dozer rips.
E5	Load-haul-dump (LHD), mucking machine, parked at D/S portal.
E6	Two LHD mucking machines removing blasted material from ECC.
E7	Two-boom drill jumbo parked at downstream portal.
E8	Drill jumbo drilling two blast holes at once, using both booms, in crown of ECC.
E9	Miners loading two part resin grout (celtite) in ECC anchor hole.
E10	Track mounted rotary drill drilling tunnel grout holes.
E11	Hitachi EX270 LC excavating downstream portal.
E12	"Snorklift" manlift used for applying shotcrete to portals.
E13	Craelius rotary drill - drilling anchor holes at downstream portal.
E14	Concrete truck and concrete pumping truck placing leveling concrete near Sta. 15+00, toe of upstream cut-slope.
E15	Same as previous photo.
E16	Mesco 870 front end loader wheel rolling impervious core against core trench abutment. Photo looks at right abutment, approximate Sta. 22+50. Front edge of bucket is near centerline.
E17	Boyles Bros. shop fabricated agitating tank/transfer tub.
CC1	(CUT-AND-COVER 1) Outlet Works Intake area. Cat 235 trackhoe excavating organic overburden and loading a Cat 631C scraper.
CC2	Outlet Works intake area, looking upstream from the portal area at the foundation for the engineered fill under the intake structure and the cut-and-cover conduit.
CC3	Constructing a drain to de-water the cut-and-cover conduit foundation. A 12-inch-diameter perforated pipe was covered with boulders and cobbles then chinked with smaller rock.
CC4	View of the foundation for engineered fill under the downstream end of the Outlet Works cut-and-cover conduit. Photo looks downstream toward the upstream portal.
Q1	(QUARRY 1). Quarry at Peoa, Utah. Looking northeast at face being worked in Nugget Sandstone.

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

PERTINENT DATA

1. GENERAL DATA

Name	Little Dell Lake
Stream	Dell Creek
County and State	Salt Lake County, Utah
Purpose	Flood Control and Water Supply

Drainage Area

Dell Creek above damsite	16.0 square miles
Parley's Creek above diversion	13.5 square miles
Parley's Creek above Mt. Dell Dam	41.0 square miles

Runoff, mean annual (1930-1968)

Dell Creek at damsite	5,600 acre-feet
Parley's Creek at diversion	5,700 acre-feet
Parley's Creek at Mt. Dell Dam	13,600 acre-feet

2. RESERVOIR DATA (NGVD)

Reservoir pool elevations (NGVD)

Inactive Pool	5,668.2 feet
Normal Maximum Operating Pool	5,785.0 feet
Gross pool at Spillway Crest	5,798.0 feet
Spillway design flood pool	5,810.0 feet

Reservoir areas

Inactive pool	50 acres
Normal Maximum Operating Pool	237 acres
Gross pool at Spillway Crest	249 acres
Spillway design flood pool	276 acres

Reservoir Storage Capacity

Inactive pool	1,000 acre-feet
Normal Maximum Operating Pool	17,500 acre-feet
Gross pool at Spillway Crest	20,500 acre-feet
Spillway design flood pool	23,000 acre-feet

Length of reservoir — 1.2 miles

3. DAM

Type	Rolled, zoned earthfill
Crest Elevation (excluding overbuild)	5,813.0 feet, NGVD
Foundation Elevation - at dam axis	5,575.0 feet, NGVD
Maximum height above streambed at dam axis	238 feet
Freeboard above spillway design flood pool	3.0 feet
Crest Length (spillway not included)	1,745 feet
Crest Width	30 feet
Crest Overbuild (varies)	0 to 1.8 feet

Side-Slopes

Downstream (Variable, depending on elevation of dam crest, accounting for camber)	1.75H to 1.0V to 2.0H to 1.0V from Crest El 5,813.0 feet to Gross Pool El 5,798.0 feet 3.0H to 1.0V from Gross Pool El 5,798.0 feet to the toe
Upstream (Variable, depending on elevation of dam crest, accounting for camber)	1.75H to 1.0V to 2.0H to 1.0V from Crest El 5,813.0 feet to Gross Pool El 5,798.0 feet 3.0H to 1.0V from Gross Pool to El 5,735.0 feet 3.75H to 1.0V from El 5,735.0 feet to the toe.

Total Embankment Volume	5,110,100 CY
Riprap, U/S Face of Dam	24-inch-thick layer of stone protection on a 9-inch-thick bedding layer from El 5663.0 feet to the Crest.

4. DIKES — None

5. SPILLWAY

Type and location	Detached, ungated, broad-crest concrete sill and unlined channel on right abutment of dam.
Crest invert length	125 feet.
Crest elevation	5,798 feet, NGVD.
Discharge capacity at spillway design flood pool (Elevation 5,810.0 feet)	16,500 c.f.s.
Exit Channel Erosion Protection	Five (5) buried concrete walls (Erosion Control Structures)

6. FLOOD CONTROL AND WATER SUPPLY OUTLET WORKS

Type and Location

Single tunnel configuration through left abutment incorporating a submerged flood control intake structure;
Single concrete cut and cover conduit section transitioning into the upstream tunnel;
Single level submerged water quality intake located at the upstream portal;
A mid-tunnel emergency control chamber;
A downstream tunnel/adit section containing a single outlet pipe;
A downstream operational control structure;
A plunge pool type energy dissipator and exit channel.

Upstream Configuration

Dual Conduits
(1) 6'-0" diameter circular flood control conduit.
(2) 2'-0" diameter circular water quality conduit.

Downstream Configuration

Single Conduit
42" diameter steel pipe housed in a 9'-6" diameter modified horseshoe, concrete-lined tunnel adit.

Intake Elevations (NGVD)

Flood control intake	5,625 feet
Water quality intake	5,675 feet

Gates and Valves

Flood control bulkhead gate (submerged, hydraulically actuated, located at intake)	One 7'-1-1/4" x 10'-2" steel.
Water quality bulkhead gate (submerged, diver installed, located at intake)	One 5'-0" x 5'-2" steel.
Flow regulating valves	Two 30" diameter jet flow gate valves.
Flow guard valves	Two 30" diameter ball valves.
Flood control isolation valve	One 42" diameter ball valve.
Water quality isolation valve	One 24" diameter ball valve.
Flow shut-off valve located at junction of Outlet Works and Parley's Creek diversion	One 42" diameter butter-fly valve.

Discharge Requirement (Flood Control)	300 c.f.s.
Discharge Requirement (Water supply)	46 c.f.s.

7. DIVERSIONS

Parley's Creek

Diversion structure	Concrete weir.
Intake weir (El. 5,850 feet NGVD)	15'W x 11'H x 20'L.
Spillway (El. 5,853 feet NGVD)	26'W x 11'H x 16'L.
Conduit	48" and 60" diameter concrete and coated steel cylinder pipe.
Length	2.45 miles.
Design Capacity	90 c.f.s.

8. RECREATION FACILITIES — Deferred

9. CHANNEL IMPROVEMENT — None

10. HYDROELECTRIC POWER FACILITIES — None

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

CONSTRUCTION CHRONOLOGY
(DAM AND APPURTENANCES)

DATE		EVENTS & COMMENTS
April	1988	Core Trench and Test Fill contract awarded to Harper Contracting, Inc. of Kearnes,Utah.
September	1988	Core Trench and Test Fill contract physically completed.
May	1989	Dam and Appurtenances contract awarded to Clement Brothers Co. and J. E. Starnes Co., a Joint Venture.
May	1989	Boyles Brothers performed exploratory drilling in the reservoir borrow area; Contractor investigated for a source of riprap, transition and drainage fill.
May	1989	Preconstruction conference meeting.
July	1989	Contractor used backhoes to explore the Reservoir Borrow Area for a source of transition and drainage fill material.
July	1989	Stripping of the dam foundation, right abutment initiated.
July	1989	Clearing and grubbing of portals initiated. Access road cut made near top of U/S portal.
July	1989	Stripping of Reservoir Borrow Area initiated.
August	1989	Excavation of the left abutment and the portals began. Access road and initial portal cuts made on or before 15 August 89. Initial top of D/S portal cut enlarged to provide access to Inclinometer I-4 on or before 22 August 1989.

August	1989	Outlet Works intake and cut-and-cover foundation work initiated with clearing, grubbing and stripping.
September (3)	1989	Excavation at the flood control intake initiated.
September (9)	1989	Downstream portal anchor drilling started.
September (13)	1989	Construction of the spillway erosion control structures began.
September (13)	1989	Preliminary cleanup of the core trench invert began on or just before 13 September 89. Work began at the base of the haul road fill near Station 16+00 and progressed left toward the bottom.
September (15)	1989	Upstream Portal anchor drilling started.
September (18)	1989	Foundation drilling and grouting was begun at Station 16+85 and progressed up the right abutment.
September (19)	1989	First rock anchors installed at downstream portal.
September	1989	Rock plant components, intended for production of drain material, began arriving on site.
September	1989	Boyles Brothers began mobilization of automated grout batch plant for foundation grouting.
September (21)	1989	Excavation of the left abutment initiated. Access pioneered to top of core trench. Work effort focused on the U/S left abutment foundation.
September (25)	1989	First flood control intake fill placed.
October	1989	Shaping of the left abutment core trench invert (Drill & Shoot) initiated coincident with excavation of the D/S left abutment excavation.
December (4)	1989	Patrick Harrison Mining Co. began tunneling with drill and shoot at D/S portal. Spiling previously installed.
December (15)	1989	Downstream portal rock anchor and shotcrete work completed.

SUMMARY		By the end of 1989 the right abutment had been stripped and at the left abutment excavation was about 80 percent complete. Dell Creek had been "moved" but still flowed through the dam foundation (streambed area). Embankment was not placed this year.
January	1990	Excavation of the D/S left abutment and streambed areas of the dam foundation, foundation grouting and upstream portal work continued into the winter. Tunnelling continued D/S to U/S, from D/S portal.
February (2)	1990	The crusher was operated for a shakedown run.
April (10)	1990	Start of the Embankment Construction Season. Excavation and preparation U/S of Station 21+50 on the right abutment dam foundation was undertaken (at the "ravine").
April (13)	1990	Upstream portal rock anchor and shotcrete work completed.
April	1990	Dell Creek location moved farther right in the U/S dam foundation area. CMP used for part of the pathway/channel.
April (18)	1990	Embankment placement initiated with Random II in the U/S shell right abutment ravine area. Weather hampered work until about 10 May 90, after which good progress was made filling in the ravine.
May (1)	1990	Second tunnel heading started at the U/S portal. Progressing U/S to D/S and D/S to U/S.
May	1990	Excavation and preparation of the U/S streambed area of the dam foundation was accomplished.
May (18)	1990	Tunnel excavation and temporary support completed.
May (21)	1990	Embankment placement began in the U/S shell, left side streambed area. This partial fill later became the cofferdam.
June (23)	1990	Dell Creek diverted from the streambed area by pumping through a pipeline through the "ravine" on the

		right abutment. The Contractor was then able to pursue placement of Random II fill in the streambed from abutment to abutment.
July	1990	Tunnel invert preparation and concrete floor "mud" slab placement initiated at U/S end of the tunnel.
July (14)	1990	Right abutment U/S shell foundation area finally excavated and prepared for Random II fill placement. This effectively allowed closure of the "cofferdam". Dell Creek being pumped around the work area.
July (20)	1990	Emergency Control Chamber excavation and temporary support completed.
August (9)	1990	Final preparation of the Core Trench invert began in the old streambed area, approximately between Stations 14+00 and 16+00.
August (15)	1990	Dell Creek Diversion relocated about this time to accommodate the advancing Random II, cofferdam, fill. New location eventually discharged into the emergency spillway.
August	1990	Excavation of weak foundation materials D/S right abutment streambed/old highway fill/ravine area accomplished.
August	1990	Boyles automated foundation grouting batch plant was demobilized. Grouting continued with smaller, bag-supplied plant.
August (21)	1990	Concrete "mud" slab placed on tunnel invert.
September (5)	1990	Concrete tunnel liner construction began.
September (13)	1990	Inclined Drain (Transition II) placement initiated in streambed reach.
September (21)	1990	Impervious core placement initiated.
October (4)	1990	Horizontal Drain Blanket placement initiated w/Transition I layer.

October (31)	1990	Embankment placement suspended for the winter.
November	1990	Dell Creek diversion relocated. A ditch was excavated across the right abutment. Water was pumped to a high point at the U/S toe of dam and discharged by gravity flow through the ditch into the lower portions of emergency spillway.
December (20)	1990	Foundation grouting suspended for the winter.
SUMMARY		At the end of 1990 embankment placement was about 9 percent complete. A small volume/area of the downstream shell had been placed. Most of the effort went into the Random II U/S shell cofferdam. The amount of impervious core placement was enough to effectively get out of the bottom. Foundation grouting was nearly completed and significant progress was achieved in construction of the concrete tunnel liner.
February (22)	1991	Concrete tunnel liner completed.
March	1991	Work on the downstream outlet works structures and cut-and-cover conduit was in progress.
March (1)	1991	Tunnel grouting started.
April	1991	Diversion now included routing flow through the Outlet Works tunnel.
April (19)	1991	Start of the Construction Season. Excavation of the dam foundation resumed with work on the downstream left abutment.
April (25)	1991	Tunnel grouting suspended. Spring runoff being diverted through the tunnel.
May	1991	Foundation preparation resumed with work in the downstream streambed area.
May (16)	1991	Embankment placement resumed with horizontal drain blanket.
May (22)	1991	Random II embankment placement resumed with work in the U/S ravine area.

June (4)	1991	Foundation grouting resumed.
June (14)	1991	Random I embankment placement resumed.
June (28)	1991	Foundation grouting completed.
July (1)	1991	Restoration of deteriorated core initiated.
July (3)	1991	Core trench invert cleanup/preparation resumed.
July (4)	1991	Final preparation and impervious core placement resumed at the right abutment.
July (12)	1991	Tunnel grouting resumed.
July	1991	Foundation excavation/preparation and embankment placement now occurring in all zones. Toe drain pipe installation at D/S toe completed.
August	1991	Parley's Creek diversion excavation and foundation backfill accomplished and work on the structure began.
August (8)	1991	Inclined (chimney) drain Transition II and Drainage Fill II widths reduced.
August (20)	1991	Impervious core material placed in the Transition II inclined drain zone downstream of the core. Change occurred at about Station 19+65.
August	1991	Haul road across the IC zone removed and moved up the right abutment. (Location had inhibited/impacted impervious core placement.)
October (22)	1991	Embankment placement operations halted by onset of winter weather. Contractor attempted to winterize/protect the embankment.
October (31)	1991	Tunnel grouting completed.
SUMMARY		At the end of 1991 embankment placement was about 42 percent complete. Tunnel and foundation grouting were complete.

February	1992	Exit channel and plunge pool construction began.
March (13)	1992	Start of the Construction Season. Restoration of the embankment began with work in the Random II, U/S shell zone. Random II placement followed soon thereafter.
March (31)	1992	Restoration of the Random I, D/S shell zone and Random I placement initiated.
April	1992	Restoration of the Impervious core accomplished. Impervious core placement initiated.
April (16)	1992	Preparation of the core trench invert/final cleanup initiated.
April	1992	Final excavation, foundation preparation, and embankment placement occurring in all zones.
May (7)	1992	Right abutment haul road phased out and Impervious Core/Inclined Drain temporary crossings constructed of fill or old flatbed railroad cars.
June (11)	1992	Construction of the Transition II wedge reverted to original design at approximately Station 23+75. Inclined (chimney) drain zones to be placed vertically for 20 feet to allow for IC drain to Transition II zone boundary problems.
June (24)	1992	Riprap and bedding placement on U/S face of dam initiated.
September (8)	1992	Random IV zone, U/S shell placement initiated, Elevation 5765 to 5770 feet.
September (17)	1992	Horizontal Drain completed.
September (20)	1992	Random IV zone, U/S shell placement ended, Elevation 5789 to 5790 feet.
September (25)	1992	Inclined Drain completed.
October (5)	1992	Last impervious core placement on the left abutment.

October (7)	1992	Last impervious core placement on the right abutment.
October (10)	1992	Dam "topped" out.
November (15)	1992	Riprap completed on face of dam.
December (2)	1992	Spillway riprap/stone protection completed.
December (16)	1992	Project considered substantially complete.
SUMMARY		The project was substantially complete at the end of 1992. However, an extensive punch-list remained to attain final completion.
March 26	1993	Local Sponsors assumed operation of the project.

Note: DATES IN ( ) ARE APPROXIMATE

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION REPORT

1. INTRODUCTION

1.1 Purpose and Scope. ER No. 1110-1-1801, dated 1 April 1983, multiple letter SPDVG (GG) 65-34, dated 8 August 1965 and SPK OM 335-2-2, dated 1 July 1978, outline the need and scope of foundation reports and authorize their preparation for major Civil Works projects. This report insures the preservation for future use of a complete record of foundation conditions encountered during construction and of methods used to adapt structures to those conditions. It will be retained for permanent record and will serve as a basis of analysis for maintenance work, any future foundation or subsurface problems which may arise, and for determining the validity of claims presented by the Contractor. The report discusses the geology and physical condition of the Embankment foundation, the Spillway foundation and the Parley's Creek Diversion Structure foundation. The geology of the Outlet Works Tunnel and the foundations for the Intake Structure, Downstream Operational Control Structure, and the Plunge Pool are also included. The report was reviewed by the Sacramento District Geotechnical Branch, Soil Design and Geology Sections.

1.2 Authorization. The Little Dell Lake project was authorized by the Flood Control Acts of 1960 and 1968. Senate Document No. 53, 90th Congress, is the original project document. The project was originally authorized for flood control, municipal water supply, recreation, and fish and wildlife enhancement. However, the project was modified to more adequately reflect existing needs. The modified project was reauthorized by Section 170 of the 1976 Water Resources Development Act (PL 94-587, 22 October 1976). A Post Authorization Change Notification Report provided the authorization necessary to continue with detailed planning and engineering of a downsized project. Additionally, the authorized recreation purpose of the project was deferred and the Emigration Creek Diversion facility was deleted from the project. Pursuant to the requirements of PL 99-88, a Local Cooperation Agreement (LCA) reflecting the reduced scope of the project was signed on 10 June 1986. This LCA addressed all applicable cost-sharing and non-Federal responsibility issues contained in PL 99-88 and the Water Resources Development Act of 1986.

1.3 Location and Purpose of Project. The Little Dell Lake Project is located about eight (8) miles east of Salt Lake City in the western part of the Wasatch Mountains. The dam is located on Dell Creek approximately 1.25 miles upstream of the existing Mountain Dell Reservoir. Dell Creek, a tributary to Parley's Creek, flows westward to the Jordan River and ultimately to the Great Salt Lake. An auxiliary diversion structure is located on Parley's Creek below the confluence of Lamb's Creek.

The diversion facility diverts flows to Little Dell Reservoir through a 2.45-mile-long pipeline that terminates at the Downstream Operational Control Structure (DOCS). The project provides flood protection and water supply along with some riparian mitigation and habitat enhancement. Flood protection will be provided for about 1500 acres of residential, commercial and industrial property in the 1300 South to 2700 South areas of Salt Lake City and South Salt Lake City. It is estimated that the project will reduce the potential flood damage in existing urbanized areas by nearly 90 percent. The project will provide a supplemental annual water supply of about 2900 acre feet for municipal and industrial use in the Salt Lake City area. Projections indicated this additional water supply would be needed in the 1990's in order to support continued growth and economic development. The project location is shown on the General Location Map, Plate 1.

1.4 Description of Project. The main project features include the dam, outlet works, spillway and Parley's Creek Diversion Structures. Project features are presented on Plate 2, Project Plan (General Layout).

1.4.1 Dam. The dam is a zoned, rolled earthfill structure with a maximum height of about 238 feet above the foundation at the axis, a length of about 1,745 feet from Station 10+39 to 27+84, and a crest width of 30 feet at Elevation 5813.0 feet. The dam was constructed to Elevation 5813 feet at the abutments with up to about two feet of overbuild at the maximum section. The downstream slope is a constant 3.0H to 1.0V from the toe to gross pool Elevation 5798.0 feet. The upstream slope is 3.75H to 1.0V from the toe to Elevation 5735.0 feet where the slope steepens to 3.0H to 1.0V. The portion of the dam from gross pool Elevation 5798.0 feet to the crest has upstream and downstream slopes that vary from about 2.0H to 1.0V at the abutments, to about 1.75H to 1.0V at maximum section. The steeper slopes toward the maximum section were required because of the 0 to 2-foot camber overbuild incorporated in the top of dam. The embankment zones include an upstream shell of Random II and Random IV material, an impervious core, an inclined drain composed of a sand transition layer and a gravel drainage layer, a blanket or horizontal drain consisting of a gravel drainage layer protected above and below with sand transition layers, and a downstream shell of Random I material. The optional upstream Random III zone was not built. There is also a Random I buttress fill about 30 feet thick (max.) that covers the downstream toe and fills the gap between the dam and the primary access road fill. Also a wastefill about 25 feet thick (max.) was placed at the upstream toe filling the gap between the dam and the cut-and-cover backfill over the Outlet Works conduit. The upstream slope is protected with a minumum 24-inch-thick sandstone riprap layer over a minimum 9-inch-thick bedding layer. The downstream slope was seeded with native grasses. A core trench was excavated into bedrock and a three line grout curtain was constructed for the entire length of the dam and extended slightly beyond the embankment-to-abutment contacts at both abutments. The total volume of material placed in the dam was approximately 5,110,000 cubic yards. Refer to Plates 3 and 4 for the Embankment Plan.

1.4.2 Spillway. The spillway is located on the right abutment in a natural draw. The centerline of the spillway channel is about 300 feet from the right end of the dam. The spillway is about 2150 feet long from the reservoir to its discharge point in a steep-sided ravine approximately 800 feet downstream of the dam. The spillway includes an excavated trapezoidal approach channel, a broad crested concrete control sill, an excavated trapezoidal exit channel, a natural draw protected with five concrete erosion control structures, and an excavated, unprotected trapezoidal training channel. The approach channel, sill and a portion of the exit channel are partially protected with sandstone riprap. The approach and exit channels have a bottom width of 125 feet with 2.0H to 1.0V side-slopes. The concrete sill is about 185 feet long, abutment to abutment, and is set into rock across the invert. The sill partially extends up the side-slopes. The sill is located approximately 85 feet upstream of the dam axis. The training channel has a bottom width of 40 feet with 2.0H to 1.0V side-slopes. The steep-sided ravine that receives spillway flows discharges in the vicinity of the Primary Access Road, Station 21+50, approximately 700 feet downstream of the dam.

1.4.3 Outlet Works. The outlet works includes a flood control intake, a Cut-and-Cover Conduit, a water quality intake tunnel with an emergency control chamber, a downstream operational control structure, a plunge pool and an exit channel. The outlet works transmits flows through the left abutment. The intersection of the dam axis and the outlet works occurs at approximately Tunnel Station 17+36 and Dam Station 10+00. The flood control intake (Invert Elevation 5625.0 feet) is located about Dam Station 13+85, 885 feet upstream of the dam axis, 145 feet from the toe of the embankment. A 6-foot-diameter circular concrete Cut-and-Cover Conduit extends from the back of the intake structure, Outlet Works Station 7+20, to the upstream portal, Station 10+40. The water quality intake port, Elevation 5675.0 feet, is positioned 50 feet vertically above the low level flood control intake, just upstream of the portal face at Outlet Works Station 10+27. From the upstream portal to the emergency control chamber there is a 6-foot-diameter circular concrete tunnel. The water quality conduit is encased in the upstream tunnel liner. The Emergency Control Chamber (ECC), located about 275 feet upstream of the dam axis, houses the water quality conduit and flood control conduit junction and associated isolation valves. From the ECC to the downstream portal at Station 26+27, the outlet works conduit consists of a 42-inch-diameter steel pipe in a 9.5-foot-diameter, modified horseshoe shape, concrete-lined adit. The Downstream Operational Control Structure (DOCS), located at the portal, houses the normal operation control valve works. Flows from the reservoir are discharged directly into the energy dissipating, riprap-lined plunge pool and then to the original Dell Creek channel via a short, riprap-lined exit channel. The center of the plunge pool is located at about Dam Station 13+35, 240 feet downstream from the visible toe of dam.

1.4.4 Parley's Creek Diversion. The diversion facility diverts flows from Parley's Creek to Little Dell Lake. The combined Spillway and Intake Diversion Structure is located on Parley's Creek downstream of the confluence with Lamb's Creek. The Spillway includes a free overflow weir and an impact type stilling basin. Upstream

and downstream channel sections were designed to insure proper diversion during high streamflow. The intake includes primary and secondary sediment basins, a debris curtain wall, trash racks, a low-flow bypass system, a pool drawdown system, and a flow control weir to insure proper main pipeline flow conditions. The diversion passes the initial 5 cfs flow in Parley's Creek through the Diversion Structure directly back into Parley's Creek. The main pipeline can transport a design flow of 90 cfs to the outlet works Downstream Operational Control Structure with a normal maximum reservoir operating pool Elevation of 5785.0 feet. The 2.45 miles of pipeline consists of a combination of 60 and 48-inch-diameter conduits designed to allow flows to either enter the lake from the diversion or to be diverted directly into the outlet works plunge pool and exit channel.

1.5 Project History. The initial geologic investigation on the feasibility of Little Dell Dam was performed by Dr. Ray E. Marsell in 1951. Dr. Marsell was a consulting geologist and University of Utah professor who described the site in a letter report submitted to the Salt Lake City Corporation. The Corps of Engineers prepared a report entitled "Reconnaissance of Little Dell Damsite, Mountain Dell Creek Near Salt Lake City, Utah" in 1954. The project was authorized by the 1960 and 1968 Flood Control Acts and a Local Cooperation Agreement was signed in June of 1986. As outlined in the Geotechnical Investigations section presented later in this report, explorations were performed intermittently between the time of Dr. Marsell's report and 1988. Construction of the Little Dell Lake project was initiated in June 1987 when the Utah Department of Transportation relocated Utah State Highway 65 and major utilities passing through the damsite were relocated. Excavation of the Core Trench to near final grade occurred during the spring and summer of 1988. Work on the Dam and Appurtenances began in May 1989 and was completed in November 1993. The Construction Chronology section, at the front of this report, provides a detailed record of the Dam and Appurtenances contract construction events and progress. A complete list of design memoranda prepared for the project is included in Chapter 9, REFERENCES.

1.6 Contract Administration. The Little Dell Lake Dam and Appurtenances contract was administered by the U. S. Army Corps of Engineers, Sacramento District, Construction Operations Division, through the Utah Area Office located in Bountiful, Utah and the Little Dell Resident Office temporarily erected adjacent to the project. Mr. Paul M. Parsoneault was the Resident Engineer and Mr. Howard Aubertin was the Assistant Resident Engineer. The Resident Office was organized into a Quality Assurance and Acceptance Unit, a Field Unit, and an Administrative Unit. A Materials Testing Laboratory was included as a part of the Quality Assurance and Acceptance Unit. Key personnel of the Little Dell Resident Office are listed below:

ADMINISTRATION	
Paul M. Parsoneault	Resident Engineer
Howard Aubertin	Assistant Resident Engineer
Joyce Lobsinger	Administrative Assistant
Roger Fulmer	Office Engineer
QUALITY ASSURANCE/ACCEPTANCE	
Howard Aubertin	Chief, 1989 to 1992
Carl Cole	Project Geologist
Michael Ramsbotham	Geotechnical Engineer
John Roadifer	Instrumentation Engineer
FIELD UNIT	
Howard Aubertin	Chief, 1992
Marcelino Sanchez	Chief, 1989 to 1992
Ed Saldana	Lead Technician (Embankment) 1992
Michael Himes	Lead Technician (Grouting)
LABORATORY	
Ed Saldana	Chief, 1989 to 1992
Dave Anderson	Supervisor (Bingham Engineering)
Dave Calderwood	Supervisor (Bingham Engineering)

1.7 Contracts. There were three Little Dell Lake project contracts, as detailed below:

Core Trench and Test Fills
Contract No. DACW05-88-C-0034
Specification No. 8333 Drawing
File No. JO-3-25-35
Contract awarded April 1988
Contractor: Harper Contracting, Kearns, Utah

Dam and Appurtenances
Contract No. DACW05-89-C-0045
Specification No. 8426
Drawing File No. JO-3-25-38
Contract awarded May 1989
Contractor: Clement Brothers Company and J. E. Starnes, a Joint Venture, Hickory, North Carolina

Riparian Mitigation
Contract No. DACW05-91-C-0084
Specification No. 8967
Drawing File No. JO-3-25-42
Contract awarded May 1991
Contractor: Reclamation Engineering, Park City, Utah

A contract for further riparian vegetation restoration on Parley's Creek was awarded in the spring of 1994.

Copies of these contracts are on file in the Office of the District Engineer, Sacramento District, Corps of Engineers, 1325 J Street, Sacramento, California. Work under the Core Trench contract was performed during the spring and summer of 1988. Work under the Dam and Appurtenances contract commenced in May 1989 and was completed in the fall of 1993. The dam was essentially complete in December 1992.

Major subcontractors are detailed below:

Subcontractor	Type Contract
Malta Construction and Tree Service 337 Mt. Yale Drive Leadville, CO 80461	Clearing & Grubbing
Boyles Brothers Drilling Co. P.O. Box 25068 Salt Lake City, UT 84125	Foundation Drilling and Grouting, Tunnel Drilling and Grouting Instrumentation Drilling
Construct Tech 9620 South 500 West Sandy, UT 84070	Structural Concrete
George W. Johansen Construction Co. P. O. Box 100 Mt. Pleasant, UT 84647	Parley's Creek Diversion Pipeline & Appurtenances
Rocky Mountain Fabrication 1125 West 2300 North Salt Lake City, UT 84116	Outlet Works Piping and Valve Works
Patrick Harrison Mining Company 10 Exchange Place, Suite 207 Salt Lake City, UT 84111	Tunnel & ECC Chamber Excavation and Initial Support

California Steel Pressure Pipe 430 North 600 West Pleasant Grove, UT 84062	Concrete Cylinder Pipe Manufacture
Slope Indicator Company P.O. Box C-30316 Seattle, WA 98103	Instrumentation

2. REGIONAL GEOLOGY AND SEISMICITY.

2.1 Regional Geology. The Little Dell Lake project area, as shown on Plate 10, Regional Geology, is in the Wasatch Mountains of Northern Utah, a subdivision of the Middle Rocky Mountains. The Wasatch Front, a steep, rugged escarpment located about 6 miles west of the project area, is the result of major active faulting. This fault zone forms the boundary between major physiographic provinces, the Basin and Range province to the west and the Middle Rocky Mountains to the east. On a regional scale the area is steep and rugged with mountain peaks averaging about 10,000 feet in elevation. Locally, the topography is somewhat subdued because of the presence of younger, softer, and more erodible rock types. The major streams in the region flow westward in steep-walled valleys cutting through the mountain range and across the geologic structure. Dell Creek flows southwestward, roughly paralleling the regional trend and joins Parley's Creek 1.25 miles downstream from the dam. The project area and surrounding region is underlain by sedimentary rocks ranging in age from Permian to Cretaceous. At the damsite, the sedimentary rocks are overlain by: Older Alluvium consisting of terrace deposits, Younger Alluvium consisting primarily of stream and narrow floodplain deposits, slopewash, and residual soil. The major regional structure is the Parley's Canyon syncline which is just north of the Uinta arch and shares a common limb with it. The central part of the syncline is a multiple fold that appears at the mountain front as two synclines, one in Parley's Canyon, the other in Emigration Canyon. The Little Mountain fault, a high angle reverse fault that parallels the regional trend, cuts the Parley's Canyon syncline and has caused it to ride up over the Emigration Canyon syncline in such a way as to cut out or truncate the intervening anticline. The fault is a major, though inactive, structure and may have several thousand feet of displacement. It cuts through the ridge between Emigration Canyon and Mountain Dell Canyon and comes within 0.75-mile of the dam. The general trend of these major structures is about N. 60° E. In the vicinity of the Little Dell Lake project, folding and faulting cause a repetition of some of the formations, but generally these structures have little effect on rocks younger than Cretaceous age. An angular unconformity separates the Frontier Formation and older rocks from the Wanship-Echo Canyon Formation and the Knight Conglomerate.

Intraformational movement has resulted in bedding-plane shearing which follows the trend of the deformed beds within the major folds. As shown on the map of the Regional Geology, Plate 10, the Geologic Map - Embankment Foundation, Plate 12, and the Geologic Map - Impervious Zone, Plates 13 through 15, faults with other orientations also exist and cause a repetition of some beds. Generally, the faulting resulted from compressional forces generated during the mountain-building episodes which ended about 25 million years before the present (b.p.). Since that time stresses have been mainly tensional. No tensional features were identified in the area of the project; however, during construction of the dam, it was observed that reverse (hanging-wall-up) movement along bedding planes within the Cretaceous age bedrock has affected overlying fluvial deposits within the reservoir borrow area. These features are the subject of an Office

Report titled "The Age of Faults in the Reservoir Borrow Area - Little Dell Dam, Utah" which was prepared during construction of the project (See Appendix 1). This report concluded that "Stratigraphically ... the last fault movement occurred prior to 60,000 to 70,000 years b.p. (Fluvial Cycle 2) and most likely well before 100,000 years b.p. In accordance with part of the Corps of Engineers active (capable) fault criteria of displacement within the last 35,000 years, all three reservoir borrow area faults are judged not capable and, therefore, do not impact the design or construction of Little Dell Dam."

2.2 Seismicity. The dam is located within the Intermountain Seismic Belt which coincides with the eastern margin of the Basin and Range Province. The major fault in the area is the Wasatch fault zone which strikes approximately north-south and shows normal fault slip along its length which is about 370 km (kilometers). Seismicity observed within the region is roughly centered on the Wasatch fault but not always coincidental with the surface trace. At the present time, some segments of the Wasatch fault zone are almost free of earthquakes. Late Quaternary faulting is shown by geomorphic evidence in many places along the zone, particularly displacements of lacustrine sediments, basal moraines and alluvial deposits (Bolt, 1986).

The escarpment of the Wasatch Front is located approximately 10 km west of the dam. Movement along the fault segment nearest the dam is dip-slip, with the west block moving down relative to the east block. Studies of the Wasatch fault zone (e.g. Smith and Bruhn, 1984) stress that it consists of discontinuous normal fault segments. The major surface faults almost coincide with abrupt topographic escarpments between alluvial valleys to the west and the Wasatch Mountains to the east. Little Dell Dam is situated on the uplifted eastern side of these escarpments. Stratigraphic studies show that normal fault movements occurred along the scarps during Pleistocene and Holocene time with the youngest scarps a few hundred years old (Swan et al., 1980).

The major Wasatch fault scarps occur as distinct segments. At least six of these segments, of which one is approximately 10 km west of Little Dell Dam, are considered to have independent Quaternary rupture histories with recurrence intervals on individual segments of 500 to 2,600 years (Swan et al., 1980). No surface ruptures have been reported in any historical event in the Salt Lake City area. Scarps at the mouth of Big Cottonwood Canyon, 16 km south of the dam, and at Little Cottonwood Canyon, 22.5 km south of the dam, have been interpreted by the Utah Geological and Mineralogical Survey as recent fault scarps occurring "less than 300 years ago...probably associated with earthquake magnitude of at least 7.1 - 7.2." Smith and Bruhn (1984) concluded that "correlations of fault displacements produced (in) earthquakes in other regions of extension indicate that magnitude 7+ earthquakes may have accompanied generation of these Quaternary scarps."

Since 1850 there have been about 40 epicenters allocated to magnitude 2.5 or greater earthquakes within 40 km of the site. Two earthquakes with magnitudes of about 5.5

have occurred within 65 km of the site. The first, consisting of multiple shocks, was felt with intensity VII at Salt Lake City on May 22, 1910. The second occurred 25 km to the west of the dam and was rated intensity VI in the Salt Lake City area. A larger earthquake, magnitude 6.6, occurred near Kosmo, Utah at the north end of Great Salt Lake on March 12, 1934. The conclusion is that the region is one of continuing seismic activity with no major event recorded since 1850. Field evidence of fault scarp morphology, scarp-derived deposition and fault trenching suggests that the recurrence interval of moderate to large magnitude earthquakes for the entire Wasatch fault zone is 50 to 430 years (Swan et al., 1980).

The fault segment nearest to the site and striking through Salt Lake City is approximately 40 km in length. Correlations of fault rupture length with earthquake magnitude indicate that if this whole segment ruptured, an earthquake of magnitude $M_L = 7.25$ would be generated (Bonilla et al., 1984). For a magnitude 7.25 earthquake at shortest fault to site distance, the expected (mean) value for horizontal peak acceleration is 0.60 g. Bracketed duration values have been correlated with magnitude for available large earthquakes by Bolt (1973). The above earthquake would have an expected duration for accelerations above 0.05 g of about 35 sec.

2.2.1 Maximum Earthquake. The most severe earthquake geologically feasible at the site is a 7.25 (M_L) magnitude earthquake produced by rupture of an adjacent segment (~ 40 km long) of the Wasatch fault zone. The peak horizontal acceleration for this event is expected to be 0.60 g with a duration (above 0.05 g) of 35 seconds. The nearest distance from site-to-surface fault rupture might be as little as 10 km. The minimum recurrence time interval for such a maximum earthquake is assessed at about 500 years (Bolt, 1984).

2.2.2 Operational Earthquake. This earthquake is taken to be the largest nearby earthquake likely to occur during the life of the project (say 100 years). The magnitude of this earthquake is estimated to be 6.5 (M_L) with a peak horizontal acceleration of 0.40 g and a duration (above 0.05 g) of 15 seconds. The source is again likely to be the Wasatch fault zone but not necessarily along the western surface traces of the frontal system. The source-site distance is estimated as 10 km or more. From various probabilistic estimates of seismicity, the minimum interoccurrence time for a damaging earthquake ($5.5 \leq M_L \leq 6.5$) along the Wasatch fault zone is about 15 years. On the assumption of independence of energy release along the various segments of the 370 km long Wasatch fault, an interoccurrence time for the Operational Earthquake is thus 50 to 100 years. Because no surface faulting events have occurred, however, in the adjacent section to the site in over 135 years, the probability of occurrence of the above Operational Earthquake is higher than these values indicate (Bolt, 1984).

3. SITE GEOLOGY

3.1 General. This section describes the physical setting and geology at the major features of the dam. Later sections describe the foundation conditions encountered and the foundation preparation performed for each feature.

3.2 Physical Setting. In the vicinity of the dam the topography is more subdued than in most of the surrounding area. Hilltops are generally rounded and smooth with rock outcrops being sparse or absent. The valley floor at the dam is relatively flat and about 700 feet wide. The valley widens rapidly upstream as the slopes on the right (northwest) side of the valley flatten considerably to form the reservoir basin. The right abutment and reservoir rim have gentle slope angles of 15 to 20 degrees. The left (southeast) abutment is much steeper with slopes averaging about 30 degrees.

3.3 Geologic Units. This section describes the geologic units encountered in the immediate area of the project. For descriptions of geologic materials of the region refer to Regional Geology, Description of Map Units, Plate 9.

3.3.1 Bedrock. Bedrock at the site consists of the Cretaceous age Kelvin and Frontier Formations which are made up of interbedded marine sedimentary rocks including claystone, siltstone, and sandstone with smaller amounts of conglomerate. Shearing and alteration of several ashy beds has resulted in weak, talcose layers within the steeply dipping bedding. One bed of expansive claystone (montmorillonitic) was encountered near the base of the left abutment. The two formations are conformable and have similar engineering properties. The Kelvin Formation is typically maroon or brownish red. Drab grays and tans are typical of the overlying Frontier Formation. Both are generally moderately indurated but contain well indurated as well as poorly indurated layers.

3.3.2 Older Alluvium. In general, the Older Alluvium consists of nearly flat-lying beds of fluvial material deposited in three distinct cycles during the Pleistocene epoch. Most of the Older Alluvium shows little evidence of induration, however the oldest of the fluvial cycles is slightly to moderately indurated. Coarse beds containing predominantly well rounded quartzite gravel, cobbles and boulders, alternate with finer clayey beds. The attitude of the beds is similar to the slope of the valley surface, dipping gently downstream and toward the modern stream channel which flows near the base of the left abutment. For a more detailed description of the stratigraphy of the alluvium refer to the office report, "The Age of Faults in the Reservoir Borrow Area - Little Dell Dam, Utah," Corps of Engineers, 1993 (Appendix 1).

3.3.3 Younger Alluvium. At the dam and reservoir area the Younger Alluvium consists of Recent channel deposits and overbank deposits. Unindurated sand, gravel, cobbles and boulders occurrs along the active channel. Overbank deposits cover these coarser materials on low terraces along the channel in several locations. A denser

layer containing boulders makes up the basal part of the Younger Alluvium immediately overlying bedrock. The overbank deposits and loose or soft channel deposits were removed from the dam foundation and from required locations at the foundations of the outlet works structures.

3.3.4 Slopewash. The slopewash which covered most of the upper left abutment prior to excavation, consisted primarily of sandy clay and silty clay with varying amounts of angular rock fragments ranging from sand to large boulder sizes. On the upper right abutment the slopewash consisted of sandy clay with variable amounts of rounded rock fragments derived from the conglomerate bed at the top of the abutment. The near-surface, organic or weak slopewash was removed from the foundation before approval was given for fill placement.

3.3.5 Alluvial Fans. Along the left side of the reservoir, gravelly materials derived from the Frontier Formation were eroded and transported downhill into the small drainages and deposited as small alluvial fans at the base of the slope. Fans along the right reservoir rim were of larger extent, less well defined, and in some cases had cut into the Older Alluvium. The materials in these localized areas were typically more variable and consisted of both gravel and clay lenses.

3.3.6 Nugget Sandstone. The quarry that produced riprap material was located within the Nugget Sandstone at an existing pit near Peoa, Utah. The site is located about 31 miles east of the damsite via US Highway I-80 and Utah Highway 189. The Nugget Sandstone is a well cemented Triassic-Jurassic age eolian (windblown) sandstone, generally pale orange or thinly bedded pale orange and white in color. (Photo Q1)

3.4 Geologic Structure. Structure in the damsite vicinity is largely controlled by the location and orientation of the northwest limb of the Parley's Canyon Syncline. The dip of the beds ranges from near-vertical on the right abutment to about 65 degrees on the left abutment. The average strike of bedding is about N.23°E., which is roughly 62 degrees from the bearing of the dam axis. As shown on plates 12 through 15, the Geology Map of Embankment Foundation and the Geologic Maps of the Impervious Zone, numerous bedding plane shears occur throughout the bedrock. Frequently, these occur along the altered ashy beds and generally result in barriers to the flow of groundwater across bedding. Numerous shears of other orientations were mapped in the foundation and may affect the patterns of seepage through the foundation. All of the shears in the foundation were in the Cretaceous age bedrock. No shears or faults were observed in the younger overlying materials except as described in the office report, "The Age of Faults in the Reservoir Borrow Area - Little Dell Dam, Utah," Corps of Engineers, 1993.

3.5 Landslides. Two relic landslides were identified at the project. A small landslide was identified in the upper part of the downstream right abutment. This feature

is shown on the Geology of the Embankment Foundation map and will be discussed further in the foundation conditions section. Most of the slide was removed during foundation excavation and, based on the size, orientation and physical properties of the remnant, no adverse affects on the embankment are anticipated. A larger relic landslide was identified along the left side of the reservoir about 1500 feet upstream of the dam. The area was recognized as a landslide when the Contractor elected to borrow construction material from the upper part of the reservoir. Numerous slide planes and springs were observed and it was realized that borrow excavation had removed the toe of a substantial slide. This may result in small-scale slope failures where the excavated slope was left steeper than the previously existing slope. Large-scale instability is not expected, but a failure would not affect the dam or appurtenant structures. In the worst case, a small percent reduction in reservoir capacity would result. Six survey monuments (BA-1 through BA-6), consisting of driven rebar, were placed in the area above the excavated slope to monitor slide activity.

3.6 Geology of Project Features

3.6.1 Dam Foundation. Plates 12 through 15 present the geology of the dam foundation. Beneath most of the dam, the downstream outlet works structures, and the spillway, bedrock is of the Kelvin Formation. The Frontier Formation makes up the bedrock for most of the left abutment and the upstream portions of the outlet works. Bedrock at the upper abutments is thinly mantled with slopewash and residual soil. Prior to foundation excavation for the dam, alluvium of the modern stream covered bedrock near the stream channel. The modern stream flowed along the base of the left abutment. In the middle part of the valley and on the lower right abutment, older fluvial deposits (Older Alluvium) cover bedrock. The core trench was excavated into bedrock. Older Alluvium also occurs as discontinuous lenses on the lower left abutment.

3.6.2 Outlet Works. Plates 28 through 45 present the geology of the outlet works. Alluvium covered bedrock at the Outlet Works Intake Structure and along most of the Cut-and-Cover Conduit. Before excavation at the Outlet Works Intake Structure, several feet of wet organic overbank deposits covered most of the surface except along several smaller active channels. Bedrock was exposed at the downstream portion of the Cut-and-Cover Conduit where alluvium, slopewash and residual soil were removed. Portal excavations encountered slopewash and residual soil at the higher elevations. Bedrock was exposed in the middle elevations of the portal and bedrock with lenses of Older Alluvium and Younger Alluvium existed at the lower elevations. The tunnel and Emergency Control Chamber (ECC) were excavated through the Kelvin and Frontier Formations. The Downstream Operational Control Structure (DOCS) was founded entirely on the Kelvin Formation, and the plunge pool wing walls were founded on Younger Alluvium and the Kelvin Formation, as discussed in the foundation conditions section of this report. The plunge pool was excavated through Younger Alluvium and into the Kelvin Formation.

3.6.3 Spillway. The Kelvin Formation was covered by residual soil and slopewash on the spillway saddle and by mixtures of residual soil and Older Alluvium (possibly re-worked) along the discharge channel.

3.6.4 Parley's Creek Diversion Structure. Folding along the Parley's Creek Syncline resulted in bending the Kelvin Formation beds so that bedrock at the Parley's Creek Diversion Structure is similar to that found in the dam foundation. As at the dam, the overbank deposits at the Parley's Creek Diversion Structure were removed and selective excavation was required to remove soft alluvial clay lenses within the coarser materials at depth. Bedrock of the Kelvin Formation, alluvium, slopewash, and residual soil were exposed in the foundation of the Parley's Creek Diversion Structure.

3.6.5 Reservoir Borrow Area. Prior to excavation in the reservoir borrow area, the gently sloping broad valley was covered with fluvial material. Almost all of the Younger Alluvium near the stream channel was removed for use as construction material for the dam embankment. Much of the Older Alluvium covering the right side of the valley was also removed and used as the primary construction material for the dam embankment. This excavation exposed bedrock of the Frontier Formation over much of the reservoir bottom. Recent alluvial fan deposits from along the reservoir rim were also utilized for construction. The Frontier Formation makes up the steep left side of the rim. The right rim is made up predominantly of Older Alluvium and alluvial fans. Small areas of the Kelvin and Frontier Formations were exposed by excavation at some locations in the downstream part of the right reservoir rim.

4. FOUNDATION INVESTIGATIONS. Extensive foundation explorations were performed before construction of the project. Explorations performed during construction were limited to: a grout testing program during the core trench contract; coring to investigate results of the curtain grouting; two trenches at the old landslide in the downstream right abutment and two trenches in the upstream right abutment foundation.

4.1 Explorations Performed Before Construction. The project was studied intermittently by the Sacramento District, Corps of Engineers since 1954. Also, the local sponsors contracted consultants to perform studies at various times since 1951. A total of 132 core holes were drilled at the project by the Corps of Engineers and others. These holes and the other explorations are detailed chronologically below. The plates showing the locations of these explorations as well as the logs of the drill holes, test pits, and trenches are contained in D.M. 10, Embankment and Spillway, September 1987, Revised 1988. D.M. 10 is on file on the Sacramento District, Soil Design Section.

Different methods of designating types and number of explorations were employed by the agencies performing the work, and these designations were carried through in this report. Core holes DH1 through DH15 were drilled by Dames and Moore. PRC-Bingham Engineering drilled holes DH-50 through DH-62. They used the same designation for a drill hole except that they used a dash ("-") and began their numbering at DH-50 which left a gap in the "DH" hole numbers between DH-15 and DH-50. The designation "TP" was used by both consulting firms to identify test pits. The Sacramento District, Corps of Engineers used a system in which the combination of a number and a letter designated the type of exploration and a following number represents the sequence in which the holes were drilled. The symbols used by Sacramento District at Little Dell Lake were as follows:

<u>First Number:</u>

1 - Diamond Core Drill Hole
2 - Auger Hole
3 - Churn Drill (Cable Tool) Hole
4 - Test Pit or Trench
5 - not used
6 - not used
7 - Undisturbed Sample Hole in which Pitcher, Dennison or similar sample barrels were used throughout the hole or at intervals in the hole.
8 - not used
9 - Rotary Drill Hole using tri-cone bits, down-the-hole-hammer or similar procedures producing chip-type samples.
10 - Becker Hammer Drill Hole in which blow counts are recorded for open or closed bit. For these holes casings are driven and air is circulated to clean out the hole producing chip-type samples less than 4 inches in diameter.

Letter Following First Number:
F - Foundation
B - Borrow

Second Number(s):
Designates the sequence in which a particular type of exploration was drilled at the project, i.e. 1F-1 was drilled before 1F-2.

The initial geologic investigation on the feasibility of Little Dell Dam was performed by Dr. Ray E. Marsell in 1951. Dr. Marsell was a consulting geologist and University of Utah professor who described the site in a letter report submitted to the Salt Lake City Corporation.

The Corps prepared a report titled, "Reconnaissance of Little Dell Damsite, Mountain Dell Creek near Salt Lake City, Utah" in 1954. No subsurface investigation was conducted at that time. In 1955, the Corps performed feasibility studies with a subsurface investigation program consisting of:

1) Twenty-three 12-inch-diameter auger holes in potential borrow areas (2B-1 through 2B-23).
2) Two NX Core holes in the dam foundation (1F-1 and 1F-1A).
3) Two churn drill holes in the dam foundation (3F-1 and 3F-2).
4) One test-pit in the dam foundation (4F-1).

In 1962, the engineering firm of Berger and Associates was contracted by the Metropolitan Water District of Salt Lake City to further evaluate the feasibility of the Little Dell Dam. The scope of the project was expanded during the course of work to include a larger reservoir as well as diversion facilities on Mill, Parley's, and Emigration Creeks that would discharge into Dell Canyon. An extensive subsurface investigation was subcontracted to Dames and Moore which included the following explorations:

1) Fifteen NX core holes in the dam foundation (DH-1 through DH-15).
2) Thirty-seven test pits located in borrow areas and adjacent to the dam footprint (TP-A through TP-Z (excluding TP-O) and TP-AA through TP-AL).

The Corps resumed the study by conducting subsurface investigations in 1970, 1971, 1973, and 1974. A summary of these explorations follows:

1970

1) One 4-inch-diameter core hole in the left abutment (1F-2).
2) One 4-inch-diameter core hole near the intake structure (1F-3).
3) Four 36-inch-diameter bucket auger holes in the dam footprint (2F-1 through 2F-4).

4) Two dozer trenches near the proposed outlet works (4F-2 and 4F-3).
5) Eight 36-inch-diameter bucket auger holes in the borrow area (2B-24 through 2B-31).

<u>1971</u>

1) Three NX core holes along the outlet works tunnel alignment (1F-4, 1F-5, and 1F-8).
2) Two NX core holes in the proposed left abutment spillway (1F-6, and 1F-7).
3) One NX core hole on the upstream right abutment (1F-9).
4) Three 24-inch-diameter bucket auger holes in the dam footprint area (2F-5, 2F-6, and 2F-7).

<u>1973</u>

1) Two previously drilled NX core holes were deepened (1F-5 and 1F-8).
2) Three previously drilled auger holes were extended and cored 10 feet into bedrock (2F-3, 2F-4, and 2F-6).
3) Nine NX core holes drilled along the proposed tunnel and outlet alignments (1F-10 through 1F-18).
4) Three NX core holes in the proposed right abutment spillway (1F-19, 1F-20, and 1F-21).
5) One NX core hole (1F-22) adjacent to DH-3 for additional foundation information.
6) One NX core hole on the left abutment for borrow material (1B-1).
7) Eight 30-inch-diameter auger holes were extended 10 feet into bedrock with 4-inch diameter and NX core barrels (2B-32 through 2B-39).

<u>1974</u>

1) Nine core holes in the dam footprint area (1F-23 through 1F-31).
2) Four auger holes in the dam foundation area (2F-8, 2F-8A, 2F-9, and 2F-10).

The U.S. Army Engineers Waterways Experiment Station (WES) continued the study in 1975 by conducting subsurface and surface investigations. Results of these investigation were presented in a report prepared by WES entitled "In Situ Seismic Investigation", Little Dell Damsite, Utah April 1976. The following explorations were performed:

1) Seven tricone rockbit holes were drilled in the upstream footprint area (9F-1 through 9F-7) in conjunction with crosshole, uphole, and wavefront testing to determine compressional wave (P) and shear wave (S) velocities in the foundation. Samples were obtained from selected intervals in several of the drill holes.

2) Five surface seismic refraction lines, 600 feet long, were conducted near 9F-1 through 9F-7 to determine (P-wave) velocities and depth to refracting interfaces.

In 1985, the consulting firms of Bingham and PRC Engineering performed explorations at the site and prepared a report titled, "Little Dell Reservoir Project - Design Report." The following explorations were performed:

1) Eight HQ wireline core holes in the foundation area.

2) One HQ wireline core hole to investigate a potential quarry site.

3) Eight auger holes in the foundation and borrow areas.

4) Forty-six test pits in borrow and foundation areas.

5) One 600-foot-long trench upstream of the dam.

In 1986, the Corps resumed work at the project. The following explorations were performed:

1) Fifty-three HQ wireline core holes at the embankment, outlet works, and spillway locations (1F-32 through 1F-84). Standard Penetration Tests (SPTs) were performed in nine of these holes.

2) Ten HQ wireline core holes at two potential quarry sites (1B-SQ-1 through 1B-SQ-7 and 1B-SC-1 through 1B-SC-3). Surface reconnaissance was performed to select a quarry site and samples were tested from four sites.

3) Twenty backhoe trenches in borrow areas (4B-3 through 4B-22).

4) Thirteen holes with alternating SPTs and 4-inch-diameter Pitcher tube undisturbed samples were drilled in the dam foundation (7F-1 through 7F-13).

5) Nineteen SPT holes were drilled in the valley using various methods to advance the holes 2F-11 through 2F-29).

6) Twenty-four Becker Hammer holes (10F-1 through 10F-24). Most of the sites were adjacent to SPT holes and consisted of two Becker hammer holes at each site, except at 10F-1 where three were drilled.

In 1987, the Corps conducted explorations at the outlet works, spillway, upstream borrow, and Parley's Creek diversion pipeline. This included:

1) Four HQ wireline core holes were drilled at the tunnel portals (1F-85 through

1F-88). At each portal, one vertical hole with SPT data in the overburden and one angle hole were drilled.

2) Two HQ wireline holes were drilled at the outlet works intake and conduit locations and two were drilled in the plunge pool foundation (1F-89 through 1F-92). SPT data were taken in all four of these holes.

3) Three HQ wireline holes were drilled at the proposed access bridge (not constructed) over the spillway (1F-93 through 1F-95). SPT data were taken in the overburden.

4) Two HQ wireline holes were drilled at the spillway sill location (1F-96 through 1F-97). SPT data were taken in the overburden.

5) Nineteen backhoe pits and four dozer trenches were excavated in the upstream borrow area (4B-23 through 4B-41).

6) Fifteen backhoe trenches and pits were excavated in the spillway discharge channel to evaluate conditions for construction of erosion control cut-off walls (4F-4 through 4F-18).

7) Three holes with SPT data and 3-inch-diameter undisturbed samples were drilled at the proposed locations of the erosion control structures in the spillway discharge channel (7F-14 through 7F-16).

8) Two 6-inch-diameter undisturbed sample holes were drilled east of the outlet works upstream portal to investigate a possible old slide area (7F-17 and 7F-18).

9) Fifty-seven backhoe pits were excavated along the proposed Parley's Creek Diversion Structure and pipeline.

10) Two test anchors programs were performed at the outlet works portals. The results of these tests are included in separate reports which are filed in Sacramento District, Geology Section, under the following titles:

Tieback Anchor Testing Program for Little Dell Dam Project Near Salt Lake City, Utah For Becho Incorporated by EarthStore, a Division of Dames and Moore, November 6, 1987.

Results of Pull Tests Conducted on Polyester Resin Grouted Bolts at the Little Dell Damsite, Salt Lake City, Utah, by Tim Avery, Waterways Experiment Station, August 1988.

4.2 Explorations Performed During Construction. During the core trench contract, WES performed a test grouting program consisting of five test holes which were drilled, water pressure tested and grouted. A final report was not prepared for this work. The field data is on file in the Sacramento District, Geology Section.

Four HQ and Nx diamond bit core holes were drilled along the grout curtain during the Dam and Appurtenances contract to investigate the effectiveness of the grouting. The locations of the holes are shown on Plate 100 and the logs of the holes are included on Plates 101 through 103.

5. FOUNDATION CONDITIONS, TREATMENT AND APPROVAL

5.1 General. This section describes the foundation conditions for each of the project features. Excavation and foundation treatment are discussed, as well as groundwater and dewatering. Geologic mapping and foundation approval procedures are described in general terms. Specific information is shown on the geologic maps and on the foundation approval maps for each feature.

5.1.1 Geologic Mapping. The majority of the geologic mapping was performed by Resident Office staff using a transit and stadia rod, and a total station equipped with an electronic distance measuring device (EDM). A sketch was made by the geologist in the field and points were surveyed at representative locations. The instrument operator recorded the point numbers and the azimuth and slope distance. This information was later entered into a Compaq 286 computer at the Resident Office and plots of the points were generated by the computer and a Hewlett-Packard 7550A graphics plotter. Software was written for this purpose by John Roadifer, a geological engineer and computer programmer assigned to the Resident Office. The geologist used the field sketch and computer plot to complete and verify the map. The Outlet Works Intake Structure and most of the Cut-and-Cover Conduit were mapped using tape and Brunton compass methods. The Station 22+00 (Station 22) Fault area in the core trench was mapped by tape and Brunton compass before final excavation removed the grout nipples. After final excavation, selected locations were surveyed with transit and stadia rod. The Parley's Creek Diversion Structure foundation was mapped by transit and stadia rod combined with tape and Brunton compass. The tunnel was mapped by taping from steel set locations surveyed by the Contractor. The Outlet Works portals were mapped by sketching between anchor locations surveyed by the Contractor.

5.1.2 Foundation Approval. A formal foundation approval procedure was developed early-on in the project. It was established that all foundations required approval by the Resident Office Geotechnical staff, as delegated by the Resident Engineer, before embankment or concrete could be placed. Generally, the Project Geologist and Embankment Engineer/Geotechnical Engineer jointly inspected and approved foundations. In their absence a staff geological engineer performed this function. An exception was directed by the Resident Engineer whereby the Chief of the Resident Office Field Unit was designated to approve parts of the tunnel invert. Initially, the Contractor's QC Chief provided a map of the areas requiring approval, then accompanied the Corps' Geotechnical staff on an inspection. If deficiencies were noted, the Contractor was required to correct them and request another inspection. The process later evolved to having the Contractor's QC/foreman marked out the area requiring approval with red paint. After the area was inspected and approved, the Project Geologist sprayed green paint adjacent to the red paint to indicate approval. The approval boundaries were then surveyed by the Corps' geologists. Later, the Contractor surveyed the boundaries and provided the data to the Government. Approval was given only after the area was mapped, photographed, adequately treated and final preparation

was completed. During the first year of placement (1990), the approval areas were given letter designations, "A" through "AE". In subsequent years, an approval designation was used which combined the date and sequence within the day, ie. area 091791a was the first area approved on 17 September 1991 and area 091791b was the second area approved on that date. Plates 22 through 27 show the approval areas (Photos EMB6 through EMB10). Some areas were too small to be shown at a reasonable scale and were combined on the map. This was especially true at the steep left abutment of the core trench where an area with several feet of vertical extent would show as a very small area in plan view. Except for the initial core trench approvals performed in the fall of 1990, individual approval sheets were prepared for most of the smaller areas but are not presented in this report. These sheets are filed in the Sacramento District, Geology Section.

5.2 Dam Foundation. Foundation treatment and preparation varied considerably in different areas of the dam. In general, as contractually required and as expected, much more work was required at the core trench foundation than at the upstream and downstream shell foundations.

5.2.1 Core Trench

5.2.1.1 Excavation. The core trench was excavated in two main phases:
1) the Core Trench Contract
2) the Dam and Appurtenances Contract.

The bulk of the excavation for the core trench was accomplished in 1988 under the Core Trench Contract during which excavation removed the overburden and generally continued several feet into bedrock. The purpose of the contract was to provide a surface suitable for inspection by the dam design team and by prospective bidders for the follow-on Dam and Appurtenances Contract. Excavation removed pervious alluvial beds and generally provided a surface adequate for installing surface pipes (nipples) for the foundation grouting. Caterpillar D8 dozers were used to rip the soil and rock, and to push the excavated material to backhoes for loading into dump trucks (Photos E1 to E4). Caterpillar 235 trackhoes and other backhoes of similar size, were used for excavating and for loading the dump trucks. Front-end-loaders were also used for loading the trucks. The excavated material was hauled to the borrow area and stockpiled according to material type. Over most of the core trench foundation, the resulting surface was near specified grade, however, some areas could not be excavated to grade using conventional excavating equipment. The Core Trench Contract did not specify the need for blasting. Therefore, a substantial area of the left abutment, and other smaller areas where hard rock beds were encountered, were not excavated to specified grade. Excavation of these harder rock areas was deferred until the Dam and Appurtenances Contract.

Much of the foundation rock deteriorated severely (air-slaked) during the winter between the Core Trench Contract and the Dam and Appurtenances Contract. Excavation in the core trench under the Dam and Appurtenances Contract consisted of:

1) removing deteriorated foundation material
2) removing muck which had collected in the lower parts of the foundation
3) blasting in areas of more resistant rock where the excavation could not be completed under the Core Trench Contract
4) excavation of the deep (6-foot) grout nipples

Work on the grout curtain began in September of 1989. The Contractor requested that grouting be allowed to begin at Station 16+85 and proceed toward the right abutment. The Contractor requested this because the excavation at the left abutment and old stream channel area had not been completed and because the intent was to build the right side of the dam first, leaving a notch at the old stream channel. This was proposed to meet design safety requirements that either the embankment be at a specified height prior to the 1990 spring run-off or provide a notched structure that would not be over-topped. This plan was later revised and the embankment was constructed without the proposed notch. In the area where grouting began, approximately 8 to 12 inches of material was excavated from the surface which had deteriorated since excavation under the Core Trench Contract. Preliminary Cleanup was then performed to facilitate geologic evaluation and inspection of the foundation during grouting.

Some of the area of the left abutment which remained high after the Core Trench Contract (Stations 12+00 to 14+00) deteriorated during the winter and was excavated using conventional equipment. In the more resistant areas, blasting was required to excavate thicknesses ranging up to 12 feet (as measured perpendicular to the final surface). At the high area near Station 16+00, blast holes were laid out but it was determined that the rock in that area had deteriorated and had become less resistant after being exposed during the winter. This area was excavated nearly to grade with a D8 dozer equipped with ripper teeth and no blasting was required. On the left abutment an uneven surface remained in the blasted areas and in other reaches of hard blocky rock. Blasting was not permitted after grouting. Some shaping of resulting irregularities and overhangs was accomplished by breaking off the corners and overhangs with conventional excavating equipment, but numerous concrete fillets were required to shape the irregularities and overhangs for proper fill placement.

After grouting was completed, the deeper grout nipples were removed as the foundation was excavated to the elevation of the bottom of the nipples. This "deeper" excavation was accomplished over most of the core trench foundation to the right of Station 16+00. Harder rock in the valley bottom and at the lower left abutment required shallower nipples which were cut off at ground surface and patched with mortar. Excavation at these locations was required only to remove deteriorated material and for shaping. The depth of grout nipples is shown on Table 6, Detailed Summary of Foundation Grout Curtain. Excavation on the left abutment was done with backhoes except for several small areas where resistant beds required ripping with D8 and D9 dozers. Final

excavation was generally done with a backhoe equipped with a smooth blade attached to the teeth of the bucket. In the area between about Stations 18+00 (Photo CT30) and 20+00, and at smaller more localized locations throughout the core trench, excavation was not taken to the full depth of the nipples. As the depth of the excavation increased, the rock in these areas became increasingly resistant. Heavy ripping or blasting would have been required to excavate to the elevation of the bottom of the nipples. The requirement to excavate to the full nipple depth was relaxed by the Resident Engineer to prevent damage to the foundation below the specified grade. The Contractor was directed to stop using heavy rippers when the excavation was within 18 inches of specified grade. Close inspection of the foundation in these areas showed all significant open fractures had been grouted (Photos CT6 and CT31). The excavation in these areas was left less than 18 inches above design grade. Treatment and cleaning of the foundation before placing fill is discussed in Section 5.2.1.4, Foundation Preparation and Treatment.

Table 1
Dam and Appurtenances Contract
Summary of Excavation Quantities

ZONE/MATERIAL	BID QUANTITY (CY) (1)	APPROXIMATE AS BUILT QUANTITY (CY) (2)	PERCENT OVERRUN/ UNDERRUN
Core Trench Excavation	30,000	24,000	-20.0
Reservoir Borrow Area Excavation	5,870,000	5,148,400	-12.3
Dam Foundation Excavation	345,000	304,000	-11.9
Foundation and Borrow Strip and Waste	450,000	450,000	0

Notes: (1) Includes the sum of a and b quantities for subdivided bid items.
(2) All quantities are affected by Contract Modifications and/or Field Changes to varying amounts.

5.2.1.2 Foundation Materials. The core trench was excavated through the overburden and generally several feet into rock in order to cut off the granular alluvium and to found the impervious core on bedrock. Bedrock could be economically

grouted whereas grouting of the alluvium was not practical. Refer to Plates 13 through 15, Geologic Map - Impervious Zone and Plate 12, Geologic Map - Embankment Foundation for details of the foundation geology. Bedrock of the Kelvin and Frontier Formations was exposed throughout the bottom of the core trench. The bedrock consists of interbedded marine sedimentary claystone, siltstone, sandstone and conglomerate with a few altered shear zones and one montmorillonite bed. Except for a small area of slopewash near Station 13+00 at the upstream cut-slope, the left abutment cut-slopes were entirely within bedrock. All of the Younger Alluvium was removed in the area of the recent stream channel between Stations 14+00 and 16+00 at the base of the left abutment and the cut-slopes were entirely within bedrock here also. From about Stations 16+00 to 21+00 substantial thicknesses of Older Alluvium were exposed in the upstream and downstream cut-slopes. To the right of Station 21+00, the core trench excavation gradually became more shallow as the Older Alluvium became thinner. Near Station 24+00, the Older Alluvium ends and between Station 24+00 and the end of dam at Station 27+84 overburden in the upper cut-slopes consists of slopewash and residual soil.

The sandstone, siltstone, and conglomerate beds of the Kelvin and Frontier Formations generally vary from moderately soft to very hard and provide a suitable foundation for the embankment. Although the montmorillonite bed, the claystone beds, and the altered beds are very soft, the lateral extent along the core trench is small. The adjacent stronger beds will provide a bridging affect at these locations which will prevent foundation failures at the weaker beds.

The weaker beds tend to deform and close fractures within them. This results in the forming of aquacludes (barriers to groundwater flow) along the trend of the softer beds. The siltstone beds and some silty sandstone beds are relatively impervious and will retard flow across bedding, however some open fractures were seen at the surface in these beds, so they may not be as effective a barrier to flow as the weaker beds. The conglomerates and some sandstone beds are very hard where unweathered and contain large open fractures (commonly 1-inch in width, rarely ranging up to 2 inches in width). These beds provide significant seepage paths within the foundation. The grout curtain should be highly effective in sealing these fractures in the top 75 feet of the foundation. Although the foundation between 75 and 150 feet deep was significantly improved by the more widely spaced grout holes at these depths as evidenced by the closure attained during the final split-spaced foundation grouting, it can be assumed that some of the fractures were not grouted. Refer to Grouting, Section 6 and Plates 51 through 82 for details of the foundation grouting. Substantial aquacludes cross the dam axis at Stations 13+60, 14+20, 15+40, 16+30, 23+60, 24+00 and 25+00. Numerous other claystone beds and minor bedding plane shears greatly reduce the bedrock permeability across bedding.

As discussed in Geologic Structure, Section 3.4 of this report, considerable bedding plane shearing occurred in the bedrock during the regional folding and mountain building which began during Late Cretaceous time and ended about 25 million years ago. Several

bedrock faults at other orientations were also mapped in the embankment foundation. The more significant of these were given names relating them to project features. They are: the Left Abutment fault (Photo GF1), the Station 22 fault (Photos CT45 through CT48), the Station 17 fault and the Upstream Toe fault. The Upstream Toe fault does not appear in the Core Trench.

The Left Abutment fault is apparently the same fault observed in the tunnel and referred to as the Set 263 fault zone. The fault is most apparent at about Station 13+80, 110 feet upstream of the dam axis where it offsets a substantial conglomerate bed. The surface trace is outside of the core trench, however the fault plane dips downstream and probably crosses the projection of the axis at depth. The projection is shown on Plate 16, Geologic Section Along Axis of Dam, Station 10+15 to Station 16+10. The reverse fault, where observed at the conglomerate bed upstream of the core trench, is a brecciated and iron stained zone about 1-foot thick with localized bending of beds near the trace. Where observed in the tunnel, a zone of numerous shears extended from about Station 17+00 to 19+50 (Outlet Works stationing) and at Station 18+35 (Set No. 263) the fault is a brecciated zone of about 4 to 6 feet thick with considerable gouge. The lack of gouge seen at the surface indicates the fault is a pathway for seepage at that location. In the tunnel, the gouge and associated springs indicate the fault is a pathway for seepage along trend but a barrier to flow across the trend.

The grouting contractor's driller indicated that grout holes were caving severely in the area of the conglomerate bed at Station 13+15. Core hole 1F-104 was drilled at this location to check the adequacy of the grouting. Severe caving was noted during the drilling of the core hole and the conglomerate bed was intensely fractured at depth. The conglomerate encountered in the hole was also considerably thicker than would be expected based on the surface exposure. It is likely that this was caused by the bed being repeated at the fault. Additional grouting was done, as described in Foundation Grout Curtain, Equipment, Materials and Techniques, Section 6.1.1.3, to assure that caving holes did not prevent the grouting of large fractures common to the conglomerate.

The Station 22 fault exists as a substantial disturbed zone at the base of the right abutment. The faulting generally interrupts bedding and will retard seepage crossing the fault planes. Numerous springs exited along the shears indicating both a lack of permeability crossing the shear planes and seepage along them. The extensive foundation grouting will prevent excessive seepage in this area as well as throughout the core trench. The drain blanket will control any seepage occurring along the fault.

As shown on Plates 13 through 15, Geologic Maps - Impervious Zone, numerous other small-displacement shears trend across bedding. They are discontinuous features, probably the result of minor adjustment that occurred during the large scale Cretaceous age mountain building. Several of these smaller shears had a significant affect on seepage at the bottom of the left abutment, near Station 14+00. A thick gray sandstone bed crosses the core trench foundation at that location. The sandstone bed upstream of the

axis is somewhat altered and softer than downstream of the dam axis. Upstream, the fractures were essentially tight, but in the downstream half of the core trench, the sandstone was harder and more brittle, and shearing resulted in fractures, perpendicular to the strike of bedding, which were large, open and stained with iron deposits. Substantial foundation treatment was required due to the condition of the harder rock downstream of the larger shear. A significant spring exited from fractures in the downstream part of the sandstone bed within the core trench. This area is discussed further in Groundwater and Dewatering, Section 5.2.1.3, and Foundation Preparation and Treatment, Section 5.2.1.4, of this report.

5.2.1.3 Groundwater and Dewatering. Numerous springs were encountered in the core trench. These are shown on the Plates 13 through 15, Geologic Maps - Impervious Zone. The smaller seeps with low flows were treated by spreading dry Portland cement on the surface immediately before placing impervious core material (Photo C32). One spring that flowed consistently through 1989 and early 1990 at about Station 16+00, 10 feet downstream of the dam axis, had essentially dried up by the time leveling concrete was placed there in late 1990. At three other locations, larger flows required the construction of sumps and pumping to control the flow until the surrounding embankment fill was at an elevation sufficient to overcome the pressure head of the springs. The sumps consisted of gravel-filled backhoe pits with various arrangements of perforated pipes embedded within the gravel. Larger (10-inch to 48-inch) diameter pipes were used to draw down the water in the sumps and smaller (4-inch to 6-inch) diameter pipes were used to assure the gravel was adequately penetrated by grout when the sumps weres grouted at closure/abandonment. The small amount of seepage as monitored at the Parshall flume indicates that total foundation seepage is quite small.

A persistent spring at the base of the left abutment, downstream of the dam axis, required a sump and a large dental concrete placement (Photos CT7 and CT8). This spring was observed at the end of the Core Trench Contract. During excavation under the Dam and Appurtenances Contract the area was over-excavated due to poor quality rock in the foundation. The foundation consisted of blocks of hard sandstone separated by large, open, and iron stained fractures. The spring apparently drained portions of the downstream left abutment through the fractures in the sandstone bed. The area was over-excavated, as described in Foundation Treatment, Section 5.2.2.3, and an 8-foot-deep sump resulted. The sump was cleaned, then a 10-inch-diameter PVC pipe, perforated at the bottom, was installed. A small quantity of gravel was placed to cover larger fractures and the perforations in the pipe. Concrete was then placed around the PVC and a submersible pump was placed inside the pipe. The sump was pumped until fill was placed 2 to 3 feet above the top of the concrete. The sump was then grouted by pumping a 2:1 (W:C) mix into the PVC pipe. With the pressure head resulting from the 9 to 10 feet of grout column it was felt that grout would penetrate the small amount of gravel and travel some distance into the larger fractures. In any case, the gravel and open fractures

will not be detrimental to the impervious core because they were covered by about 7 feet of concrete. It appears that the softer sandstone upstream of the axis is not capable of transmitting large amounts of water.

A second sump was required in the core trench at a spring along the Station 22 fault zone. Shear planes within the fault zone retard or interrupt seepage moving along fractured beds and bring the seepage to the surface. A shallow temporary sump was installed at the toe of the upstream cut-slope to prevent seepage from running down the core trench as fill was being placed below. When the fill reached the location of the sump a deeper excavation was made and an 18-inch-diameter corrugated metal pipe (CMP) and two 4-inch-diameter PVC pipes were installed in the excavation (Photos CT33 through CT35). The bottom part of the pipes was perforated. The excavation was then filled with Drainfill I gravel. A submersible pump was placed in the CMP to keep the water drawn down until the fill reached an elevation of about 20 feet higher than the water level in the sump. Extensions were added to the pipe so that, when grouted, the grout in the pipes would have sufficient pressure head (about 24 feet) to penetrate the gravel in the sump. Grouting was begun with a 2:1 (W:C) mix pumped into the PVC pipes while pumping water from the CMP. When thin grout was seen in the submersible pump discharge, the pump was removed. Grouting in the PVC pipes continued with 2:1 then 1:1 (W:C) mixes until they would take no more grout. The CMP was then grouted with 1:1 and 0.8:1 (W:C) mixes. The 24-foot-long CMP was filled to the top with 0.8:1 (W:C) grout and left standing until the grout set up so that the grout would displace water in the gravel and penetrate fractures covered by the gravel.

The third sump in the core trench was required at Station 22+93, 20 feet upstream of the dam axis. The area was initially treated with dry cement and covered with impervious core. A significant spring above the area continued to flow down and saturate the fill so that placement could not continue. A backhoe was used to excavate the saturated fill and continued the excavation into bedrock. The bedrock excavation was then filled with Drainfill I gravel. A 24-inch-diameter CMP was placed with perforations in the gravel zone. A 4-inch-diameter PVC pipe was placed at the north edge of the sump with about 1-foot of the perforated section embedded in the gravel. A second perforated PVC pipe was installed at the spring above the sump and gravel was placed in a narrow band connecting the spring to the sump. Extensions were added to the pipes as fill was placed over the sump and spring. When fill was sufficiently high, the sumps were grouted in a manner similar to that described above for the second sump. In this case the discharge pumping was continued until a rich grout mix was observed in the discharge.

Significant seepage emerged along the fault in the upstream cut-slope near Station 17+00. Dry cement was spread over the seep immediately before placing impervious fill but was not effective in sealing off the seepage. This was partly because the geometry of the fault plane allowed the water to seep out of the cut-slope above each increment of fill placed. Due to the location on the upstream cut-slope the seep was not

considered a threat to the integrity of the impervious core but caused some difficulty during fill placement. Saturated fill was removed and replaced on several occasions before the seepage was covered by sufficient fill to prevent saturation.

Numerous springs were treated with dry cement in the area of the Station 22 fault zone. Several seeps issued from fractures in the area of the large concrete leveling placements between Stations 14+50 and 15+60. The seepage was slow and was not specifically treated other than vacuuming water from the lowest depressions immediately before placing concrete. Inspection before fill placement showed the seepage did not re-appear at the edges of the concrete or migrate to other areas.

5.2.1.4 Foundation Preparation and Treatment. The foundation was thoroughly cleaned of all loose or objectionable material before it was approved for fill or concrete placement. Generally, high pressure air nozzles were used to clean the foundation after excavation to grade (Photos CT3 and CT18). In some areas of hard rock, water or combination air-water nozzles were used. All open joints wider than about 1/32-inch were filled with mortar consisting of Portland cement and sand (Photos CT25 through CT29). Joints filled with soft or erodible material were cleaned out to a depth of one to three times the joint width and backfilled with mortar. All significant overhangs were corrected either by placing formed concrete fillets or by removing the overhang by excavation. Concrete dental placements were used to improve the foundation where soft erodible material was encountered and removed. Concrete was also used to level the foundation at some locations. See Plates 91, 92 and 93, for locations of foundation treatment, and to photographs CT2 through CT5, CT9 through CT18, and CT21 through CT30, for examples of the foundation preparation and treatment.

Much of the foundation consisted of siltstone, sandstone and claystone layers which deteriorated after varying periods of exposure. Most of the softer rock air-slaked if not covered within 24 hours. Other beds deteriorated over much shorter periods, some as short as 1-hour. When beds deteriorated due to exposure, the Contractor was required to prepare the foundation again. In many cases this meant using high pressure air nozzles to strip the deteriorated material from the foundation. Where the foundation consisted of the harder sandstone and conglomerate beds it could be left exposed for extended periods without deterioration.

As described above in the discussion of faults within the core trench, the worst foundation conditions encountered in the core trench were at the base of the left abutment, downstream of dam axis at Station 14+00. A significant spring emerged through large open fractures at this location. Mortaring of open joints proved to be inappropriate in this location because open fractures separated the rock into small blocks which moved when wheel rolling the impervious core against the abutment. There was also concern that the loose blocks would re-adjust under the load of the embankment. Attempts to remove unsuitable material resulted in over-excavation to about 8 feet below the surrounding area. The depression was used as a sump to control the spring and later

concrete was placed around the sump pipe as a dental placement. Refer to Groundwater and Dewatering, Section 5.2.1.3, above for details of the sump. Shearing resulted in deterioration of the rock in the foundation of the lower left abutment above the sump. The problems with final cleanup and joint mortaring existed in this area also. In order to stabilize the foundation, three substantial concrete fillets were placed in sequence as the fill rose in elevation. Each successive fillet overlapped and was partially founded on the preceding fillet. In the area around the fillets, the deeper, more open joints were filled with a 1:1 (W:C) grout mix poured into them at the surface. Other fractures were mortared, and another small fillet was placed just upstream of the three-tiered fillets. Upstream of the dam axis the sandstone bed is softer and intensely fractured. Concrete was placed here because it was more efficient than attempting to mortar all the joints.

Numerous depressions resulted from excavation of the hard, blocky sandstone beds between Stations 14+45 and 15+50. A depression also resulted near Station 15+30 where black, platy claystone deteriorated during cleanup. Water used for washing the harder beds settled in lower areas and each sequence of washing and clean up left the depression in the claystone area deeper. Numerous leveling concrete placements were utilized to facilitate fill placement and compaction in these areas. The area is shown in photograph CT11.

Several small springs which were observed just downstream of Station 16+00 resulted in a small depression. The Contractor used the area to collect runoff from precipitation and the drilling and grouting operation. Repetitive cleaning of the sump resulted in a deeper depression. Leveling concrete was used at this location to facilitate fill placement and assure proper compaction.

An area upstream of the axis between Stations 16+50 and 16+80 was used as a sump to collect seepage from the Station 17 fault in the upstream cut-slope. A depression resulted at this location. The Contractor elected to place leveling concrete at his own expense in this location.

Directed over-excavation of soft zones within hard sandstone beds required the placement of dental concrete at three locations between Stations 19+10 and 20+25 and at an isolated location at the downstream edge of the core, Station 20+74. Removal of the very soft clayey material along these beds resulted in an excavation with protruding ribs of harder rock. The soft material was removed by pick and shovel until the depth of the excavation was three times the width or until a hard bottom was reached. This generally resulted in 3 to 4-foot-deep holes which were then filled with concrete.

Numerous concrete fillets were used to correct overhangs in the harder rock beds on the left abutment. These are shown on the Core Trench Foundation Treatment Map, Plates 92 and 93. In several cases, large open fractures were observed in the rock to be covered by the fillet and these were filled with a 1:1 (W:C) grout mix. The concrete fillets were formed so that the resulting sloped surfaces were generally no steeper than

70 degrees from horizontal. The fillets were not feathered out at the edges and for the most part were greater than 18 inches thick except at the edges which were often only 6 inches thick. This treatment was usually required in the hard sandstone and conglomerate beds. Minor shaping of these very hard beds was done with jackhammers, backhoes and dozers, however they were difficult to shape with this equipment. Large backhoe-mounted pneumatic hammers were considered beyond the scope of the contract. Also, shaping was difficult because the major plane of weakness of the rock is along the bedding which dips steeply into the left abutment. When attempting to shape the hard rock by breaking off overhangs, the rock commonly broke along a bedding plane higher up the abutment and created a higher overhang.

A thin (6-inch-wide), partially indurated, gravelly, sandstone bed crosses the dam axis at Station 20+45. The bed was uncharacteristically friable and porous. It was excavated to a depth of about 18 inches and backfilled with concrete. A grout nipple was placed directly into the bed but the grout take was minimal.

5.2.2 Upstream and Downstream Embankment Shell Foundations

5.2.2.1 Excavation. Excavation at the upstream and downstream embankment shell foundations began in 1989 with the stripping of the right abutment (Photos EMB2 and EMB3) and valley sections and stripping and excavation at the left abutment (Photo EMB4). The core trench area had been stripped under the previous contract. The stripping operation removed the weaker surface materials, including organics and low density soils. This consisted of the grass, shrubs and root mat, and soils affected by weathering. Stripping of the upstream left abutment essentially excavated to an acceptable surface. The firm slopewash was considered suitable foundation. The design required excavation of overburden soils to expose bedrock at the downstream left abutment. This was done so that any seepage exiting bedrock under the downstream shell would have direct access to the drain blanket. Due to the difficulty of the equipment operating on the steep slope, the Contractor elected to start at the top of the downstream left abutment, stripping and excavating to rock as one operation. The foundation deteriorated between the time it was stripped and the time it was covered with fill, as long as 18 months later. This required additional excavation which was performed in increments as the fill advanced. The initial stripping and combination stripping/excavation was performed with D8 dozers making benches of excavated material at the top of the abutments and working them down the slopes. Front-end-loaders and backhoes loaded dump trucks at the toe of the excavated material when it was advanced to the valley floor. Additional excavation of the deteriorated foundation was generally done by scraping the abutment with trackhoes in increments as the fill advanced up the abutments. Hand labor was used to remove loose material left on the surface by the trackhoes.

Explorations indicated that the low density of the top 12 feet of the Younger Alluvium in the valley would not provide suitable foundation for the embankment. This material was removed, leaving the more dense alluvium below in-place.

Anomalous conditions were encountered between Stations 16+50 and 17+50 and 200 to 400 feet downstream. Very soft, saturated, fine grained soil along the steep right abutment slope in this area required directed over-excavation. The material did not appear similar to either the Younger Alluvium or the Older Alluvium. It may have been fill related to construction of the old highway which was relocated from the area; or to the small, old reservoir embankment that was removed at the downstream right embankment shell foundation.

Prior to the beginning of construction, a ravine ran along the base of the steeper part of the right abutment, crossed the core trench at about Station 21+00 then traversed to the left and terminated as a dry reservoir behind a small embankment. Soft and organic soils occupied the bottom of the ravine to depths that were deeper than anticipated. Additional excavation was directed in order to expose adequate foundation conditions along the ravine. The old embankment was removed exposing a small concrete culvert at its base which was also removed. The ridge between the ravine and the core trench was later removed, at the Contractors option, to facilitate placement of drain fill.

The Contractor elected to excavate a ditch to bury a power line running to the grout batch plant located at the upstream shell foundation. The steep-walled ditch ran perpendicular to the dam axis at about Station 19+00. Before embankment placement was allowed at the ditch location, the line and temporary ditch fill were removed and the slopes were flattened to allow the use of specified compaction equipment.

The Contractor elected to excavate a ditch for diversion of Dell Creek across the right abutment near Station 23+50. Diversion was accomplished by pumping water from the upstream portal area up to this elevation then dumping the water into an open ditch upstream of the core trench. The water flowed from the open ditch into a pipe covered by fill in the core trench then out to another open ditch at the downstream shell foundation. The fill over the pipe in the core trench was used for a haul road, and as the core trench work encroached upon the haul road, safety concerns caused the road to be moved further into the abutment. A high, steep cut-slope resulted from this activity and required shaping before fill could be properly placed. This cut-slope revealed a relic landslide in the downstream side of the upper right abutment. Excavation for the ditch and road, and the resulting remedial flattening of the cut-slope, removed much of the toe of the slide. The remaining material near the bottom of the slide did not appear to be weak or compressible. The direction of movement along the old slide was toward the valley. The embankment buttresses the slide to prevent renewed movement in that direction and the geometry of the slide and the abutment will prevent sliding toward the downstream toe. Two foundation inspection trenches were excavated in the area of the slide and later backfilled with drainage fill gravel. The upper part of the clayey slide

debris was desiccated and contained abundant slickensided planes. This material was judged to be unsuitable for foundation and 3 to 5 feet was removed from the foundation between Stations 24+00 and 25+00. A similar material was encountered at parts of the upstream right abutment but was not associated with a definable slide. The weaker upper parts of that area were also removed.

During the Core Trench Contract a test fill was constructed at the upstream embankment shell foundation between Stations 18+00 and 19+00 (approximately). The test fill was removed by excavation before placing Random II fill during the Dam and Appurtenances Contract.

5.2.2.2 Foundation Materials. The downstream shell at the left abutment was founded on bedrock. Essentially all overburden was removed so that seepage through the bedrock would have unimpeded access to the drain blanket and would not build up pore pressures in the foundation. Bedrock at this location consisted of harder sandstone and conglomerate layers, interbedded with silty sandstone, siltstone, and claystone beds. The sandstone and conglomerate beds contain open fractures and should provide good drainage of the abutment. A small patch of slopewash was left in place at about Station 13+70, between 330 and 460 feet downstream. It was not removed because excavation would have caused a vertical or overhanging condition in the foundation which would have required substantial excavation to correct.

The upstream left abutment was founded on bedrock, slopewash and a small lens of cobbly Older Alluvium. See Plate 12, Geologic Map - Embankment Foundation, for the distribution of the various materials in the foundation. The weaker, near-surface overburden was removed when the surface was stripped. The firmer slopewash was left in place in accordance with design. Due to the length of time the stripped surface was left exposed, additional excavation was required as the fill advanced up the abutment. The slopewash consisted of grayish and yellowish brown sandy clay with variable percentages of angular rock fragments. For the most part the rock fragments consisted of the harder sandstone typical of the Frontier Formation and ranged in size from gravel to large boulders. It was determined during design that the slopewash would provide an adequate foundation for the upstream shell embankment. The foundation was thoroughly inspected before each increment of fill placement and weaker, softer materials were removed. The slopewash was relatively impervious, with the exception of thin layers close to hard rock outcrops where it contained a large percentage of rock fragments. The permeability of the Older Alluvial lens is probably greater than in the surrounding slopewash. The lens consists of hard, dense, and well rounded gravel and cobbles in a gray, clayey sand matrix. Bedrock was exposed along much of the base of the left abutment, and over most of the foundation near the core trench. Interbedded sandstone, conglomerate, siltstone and claystone layers, typical of the Frontier Formation, were encountered. No foundation treatment was required at the upstream shell foundation on the left abutment.

Bedding plane shearing and other faults were observed at numerous locations on the left abutment. All shearing was confined to the Cretaceous age bedrock. Several instances of bedding plane shearing, as described in Geologic Structure, Section 3.4, were observed and are shown on the geologic maps. Two significant faults cross bedding in the upstream shell foundation and several other discontinuous faults cross bedding on the left abutment. The two significant faults were given the names Left Abutment fault and Upstream Toe fault for purposes of discussion and identification during construction. The Upstream Toe fault was first observed where bedrock was exposed at Station 12+35, 550 feet upstream. The fault trace was covered with alluvium in the valley bottom but a shear with a similar trend was observed in a dewatering ditch at Station 14+55, 680 feet upstream and is probably the same fault. The Left Abutment fault roughly parallels the dam axis at about 100 to 150 feet upstream and dips downstream under the core trench. A fault zone with a similar trend was encountered in the tunnel and is thought to be the same fault. It was called the Set 263 fault zone in the tunnel, where the extent of the disturbed rock was much larger. At the surface of the left abutment the fault exists as a narrow band about 1-foot-wide where beds were offset along a broken rock zone. Substantial gouge did not extend to the surface but a gouge zone about 4 to 6 feet wide had formed where exposed in the tunnel. Also shearing and alteration was observed over a 140-foot-section along the tunnel. The Left Abutment fault is a compressional feature which apparently ends in the montmorillonitic bed at Station 14+20, 120 feet upstream. Several faults of similar trends but smaller extent were mapped in the downstream shell foundation.

As described in Core Trench, Section 5.2.1, the patterns of permeability in the left abutment foundation are strongly affected by shearing. Where reservoir seepage has access to the surface trace of the Left Abutment fault, seepage can enter the foundation upstream of the core trench. There will be direct access for seepage where the fault exists above the fill within the reservoir, however the pressure head is not high at this location and significant losses are not expected. Also, see the discussion of foundation grouting of the left end of dam, Section 6.1.2. Seepage through the Younger Alluvium left in place under the upstream shell will give indirect access to the fault via the open fractured conglomerate bed at the lower left abutment. The grout curtain will prevent excessive seepage through the foundation at this location.

Offset of bedding along the Upstream Toe fault will probably retard seepage through bedrock on the left abutment, however, this cannot be quantified.

The valley section of the dam foundation is underlain by bedrock and a relatively thin veneer of Younger Alluvium. During design, Becker Hammer Tests and Standard Penetration Tests indicated the lower portion of the alluvium would provide an adequate foundation for the shell of the dam. In the upstream foundation, the pervious nature of the gravelly and cobbly alluvium provides access for seepage to the fractured rock in the foundation. For this reason the alluvium was completely removed and Random II fill was placed directly on bedrock in an area between Stations 14+00 and 16+00, extending

from the core trench to 170 feet upstream of the axis. In the upstream foundation the alluvium was proof-rolled with a vibrating roller compactor before foundation approval was given. At the downstream foundation, the alluvium was proof-rolled to identify soft spots but was later scarified to prevent sealing off seepage from the alluvium into the drain blanket. Due to high moisture content, areas between Stations 16+00 and 17+00, and between 300 and 500 feet downstream required scarification and re-compaction to improve the foundation before fill was placed.

Right of the valley section, between Stations 15+00 and 25+00, the embankment shells were founded primarily on Older Alluvium. Bedrock was exposed at the ravine extending upstream from Station 21+00 and in an area extending about 250 feet downstream from the core trench near Station 16+75.

The Older Alluvium under the upstream shell foundation was known to be the weakest of the foundation materials (See Appendix 1 for more information on this material). This Older Alluvium consists of two fluvial cycles, each containing a coarse grained gravel layer (GC) overlain by a fine grained clay layer (CL). A coarse grained layer, the "basal unit", consisting of gravel, cobbles and boulders in a clayey sand matrix overlies bedrock. A fine grained, intermediate clay (CL) layer overlies the basal unit. The "upper gravel layer" overlies the intermediate clay layer and the "upper clay layer" overlies the "upper gravel layer". The foundation surface at the beginning of construction was the top of the upper clay layer. Although dense and strong, the coarse grained layers contained well rounded, hard cobbles and boulders and were pervious. A primary purpose for excavating the core trench was to cut off seepage through these layers. Testing of the fine grained layers during design proved them to be relatively weak when saturated and unconfined. During proof-rolling it was confirmed that part of the upstream shell Older Alluvium foundation was saturated and relatively weak fine grained clay (CL). An area between Stations 18+00 and 19+50 and between the upstream toe of embankment and 250 feet upstream of the dam axis showed significantly higher deflections when proof-rolled with loaded scrapers. Two test pits were dug in the area to investigate the possibility of removing the top several feet of the saturated foundation or excavating to one of the stronger coarser beds. The material encountered was saturated and fine grained to the bottom of the pits at about 7 feet deep. Previous explorations indicated the shallowest coarse grained bed was at least 15 feet deep in the area. Pocket penetrometer tests in the pits indicated unconfined shear strengths ranged from 0.65 to 1.25 tons per square foot (tsf), with most of the tests resulting in readings between 1.0 and 1.25 tsf. Engineering Division was consulted as to the best course of action. It was determined that substantial additional excavation was not warranted or practical, and that shallow excavation would not significantly improve the foundation conditions. The area was scarified and the Contractor was directed to place Random II fill on the coarser side of the specified gradation. Close inspection of the first lifts indicated adequate compaction was achieved. Additional instrumentation was installed to monitor the performance of the foundation in this area. In general, although some

deflections were recorded in inclinometers, the movement was less than the threshold values selected during design. Refer to the Instrumentation Report, Sacramento District 1993, for a more detailed discussion of the additional instrumentation and the results recorded. The middle part of the downstream shell, between Stations 17+00 and 22+00, was founded on firm Older Alluvium. Excavation of the ridge downstream of the core trench resulted in much of the upstream one-quarter of the downstream shell being placed on the dense basal unit of the Older Alluvium. Downstream of that area the majority of the shell was placed on the fine grained intermediate clay layer and the upper clay layer. Between Stations 17+00 and 19+00 at about 500 to 550 feet downstream of the dam axis, the basal coarse grained layer and the upper gravel bed appear to be connected. After removal of the anomalous soft material near Station 17+00, discussed in Excavation, Section 5.2.2.1, no particular problem areas were observed in this part of the foundation.

To the right of Station 22+50 the downstream shell was founded on a combination of bedrock, slopewash, and a relic landslide. The landslide is discussed above in Excavation, Section 5.2.2.1. The foundation in this area is relatively strong and incompressible. No problems are expected.

To the right of Station 24+50, the upstream shell is founded on slopewash and bedrock and should not experience any problems.

5.2.2.3 Foundation Treatment. Foundation treatment at the shell foundations included proof-rolling and compaction of the soil foundation, dry cement placed on wet spots and removal of loose rock by hand. Generally, six (6) to eight (8) passes of the specified roller compactors were required. Where slopes were too steep for proof-rolling, the slopes were visually inspected and any unsatisfactory materials were removed from the foundation. Except at the soft area between Stations 18+00 and 19+50, upstream, the only other foundation treatment was the use of cobbly bridging layers at small isolated locations in the upstream right abutment where the fine grained Older Alluvium was wet and soft. The only special foundation treatment performed on the left abutment downstream shell foundation was in areas where large open fractures were observed at the surface. In numerous locations drain fill gravel was placed in and over the large fractures to assure that the transition sand would not infiltrate into the foundation and be transported downstream. Unusual or special foundation treatment was not required on the downstream right abutment, including the area underlain by the relic slide. Although not required, the two exploratory trenches excavated through the slide were backfilled with Drainfill II (gravel) to the surface to promote groundwater or seepage access to the drain blanket.

5.2.2.4 Groundwater, Dewatering and Diversion of Dell Creek. Other than a minor seep which emerged at Station 18+60, 305 feet upstream, no groundwater or springs were encountered except in the valley bottom and at the base of the left abutment. Five (5) sumps were constructed in the upstream shell foundation and six (6)

were constructed in the downstream shell foundation. Refer to the Plate 21, Contour Map, for the locations of the sumps. Backhoe pits were excavated from 2 to 4 feet deep at the spring locations and gravel was installed around a perforated CMP in the excavation. Transition sand was placed over the gravel and a pump was installed inside the CMP. After the fill had been placed to a sufficient elevation to overcome the pressure head of the spring, the sump was backfilled. Grout was used to backfill the sumps under the upstream shell. Drainfill gravel and transition sand backfill and cover the sumps under the downstream shell. Gravel-lined shallow ditches were used to collect water near sumps where seepage exited the foundation at more than one location. The seepage flowed to the sump along the gravel collectors. Care was taken to restrict the gravel to short distances and generally have them oriented parallel to the dam axis so that long upstream to downstream seepage paths were not built into the foundation. A sump near Station 14+15, 100 feet upstream, utilized extensive gravel-filled ditches. Several PVC pipes were installed into the gravel to assure that the gravel was grouted when the sump was grouted. The largest of the sumps was located at Station 13+10, 740 feet upstream, which is slightly upstream from the upstream toe of the embankment. Collector ditches ran out parallel to the toe of dam about 120 feet right and 80 feet left of the sump. A backhoe was used to excavate a hole which was about 17 feet deep and 25 feet square at the top, narrowing at the bottom. The excavation penetrated into a hard sandstone bed with open fractures. A 48-inch-long slotted CMP was placed in the hole and it was gravel packed. When use of the sump was discontinued, the bottom 7 to 8 feet was filled with gravel and the top 10 feet was backfilled with concrete. Several feet of clayey Random I fill were placed over the location and the area was later used as a waste fill for oversize material.

During construction in the summer 1991, flow at the drainage blanket outfall pipe was measured at 70 gpm. By the fall of that year the flow had decreased to 20 gpm. At these times, water from the sumps in the upstream foundation was being piped across the core trench and allowed to enter the drainage blanket downstream of the core. Seepage from the springs at the downstream foundation was being collected in the drain blanket. Seepage from the Station 22 fault, estimated at less than 2 gpm, was being drained to the downstream shell foundation above the area covered by the drain blanket. Seepage from the Station 17 fault, estimated at less than 0.5 gpm, was being ponded and periodically pumped away. Water produced from the upstream toe sump was pumped into the Dell Creek diversion system and was not measured.

Diversion of Dell Creek was accomplished in the following five steps:

1) During the Core Trench Contract in 1988, a CMP was placed across the core trench at about Station 14+50. Minor channelization diverted the flow into the pipe as it crossed the core trench. The CMP was covered by temporary fill.

2) During the Dam and Appurtenances Contract in April 1990, a diversion ditch was excavated from about Station 14+50 at the upstream toe, to 15+50 at the dam axis

and 14+50 at the downstream toe. A CMP flume, elevated on timbers, was placed across the core trench at Station 15+50.

3) Pumped diversion began in June of 1990. Pumps were set up near the Outlet Works Flood Control Intake and Dell Creek was pumped through pipes up the right abutment to the ravine that crosses the core trench at Station 21+00. In August, the pipeline and several stages of ponds and pumps were used to pump Dell Creek up beyond the right end of the dam where it discharged into the emergency spillway.

4) In November of 1990 the Contractor elected to excavate a ditch across the dam foundation and divert through a CMP across the core trench at Station 23+50.

5) In April of 1991 diversion through the outlet works tunnel began.

5.3 Outlet Works

5.3.1 Description of the Outlet Works. The Outlet Works consists of the following elements:

1) A submerged concrete intake structure located 365 feet out into the reservoir from the upstream portal.

2) A 6-foot-diameter (ID) concrete Cut-and-Cover Conduit placed on engineered fill, connecting the intake structure to the tunnel at the upstream portal.

3) A tunnel and Emergency Control Chamber (ECC) excavated through the left abutment. Plates 5 and 6 provide details on the upstream and downstream portals and Plate 30 (location detail) shows the details on the tunnel configuration. The upstream 330 feet of the tunnel was excavated as a horseshoe-shaped opening approximately 11 feet wide by 11 feet high. A circular 6-foot-ID reinforced concrete lining was placed in the excavation. The ECC was excavated to approximately 36 feet wide by 28 feet high. The reinforced concrete lining was placed as a 28-foot-wide by 17.5-foot-high horseshoe. The downstream adit tunnel was excavated as a 13-foot-wide by 12-foot-high horseshoe and was lined with a 9.5-foot-wide by 7.3-foot-high horseshoe-shaped reinforced concrete lining.

4) The Downstream Operational Control Structure (DOCS), a two-story concrete structure located adjacent to the downstream portal.

5) Wing walls adjacent to the downstream end of the DOCS.

6) A riprap-lined plunge pool downstream of the DOCS.

7) A riprap-lined discharge channel with a concrete sill at the downstream end, just upstream of the convergence with the existing Dell Creek stream channel.

5.3.2 Upstream Portal and Intake Structure.

5.3.2.1 Upstream Portal. Plate 28, Geologic Map of Intake Structure and Cut-and-Cover Conduit foundations shows the geologic materials encountered in the excavation for these structures. Plate 29 shows the rock anchor and shotcrete system employed for the portal excavation. The portal excavation was begun in slopewash at the upper elevations and encountered residual soil and weathered rock in the middle part of the excavation. At the lower elevations of the cut-slope and at the vertical portion of the excavation, bedrock of the Frontier Formation was encountered. The upstream and downstream parts of the vertical cut were in slopewash and the middle part was in bedrock of the Frontier Formation. Thin lenses of Older Alluvium were encountered at the upstream and downstream ends of the vertical cut, occurring between the bedrock and slopewash.

The Contractor's surveyors staked the top of the portal excavation incorrectly, causing the cut to intersect a pre-existing exploration road cut above the portal. This confusion caused the excavation to exceed the design limits and resulted in over-excavation, an increase in shotcrete quantities and a number of additional anchors near the top of the portal excavation.

Nearly all of the portal excavation was done with conventional equipment. Two small blasting rounds were required where unrippable hard rock was encountered while excavating the vertical cut. The highly fractured, blocky nature of the bedrock resulted in an uneven excavated surface. At both portals the Contractor elected to leave the excavation unsupported for heights greater than anticipated by the designers and larger areas were left exposed for extended periods before shotcrete was applied. Deterioration due to stress relief and exposure resulted in surfaces rougher than would otherwise have occurred. The Contractor stated that he used more shotcrete than he had anticipated and, as of this writing, the Contractor has requested additional compensation.

An adverse orientation of joint sets was observed in the sloping excavation before beginning the vertical wall excavation at Elevation 5642.5 feet. The Government directed the Contractor to install vertical anchor bars in the area on the bench at Elevation 5642.5, behind the vertical face, to pre-support the vertical section before excavation. No problems occurred in the area.

Two intersecting shears resulted in an unstable wedge of rock in the north wall of the vertical cut. The Government directed the Contractor to install an extra anchor through the wedge to assure the stability of the wall. Movements recorded in Inclinometer I-3A decreased and eventually stopped after installing the additional anchor.

5.3.2.2 Intake Structure and Cut-and-Cover Conduit. The surface of the area was covered by several feet of weak organic material when excavation began. Although explorations had indicated this material would exist at the surface, greater thicknesses than anticipated were encountered. The Government directed the Contractor to remove all the weak organics from the foundation (Photo CC1), resulting in a 52

percent overrun of the estimated 2000 CY unclassified excavation. Below the organic layer, the foundation consisted of Younger Alluvium. Explorations indicated the upper 12 feet of alluvium was of lower density than a basal cobble and boulder layer which overlies bedrock. The upper material was removed to expose the more dense alluvium and bedrock at the Intake Structure and along the Cut-and-Cover Conduit foundations. The geologic map shows mostly cobbles and boulders from the intake apron, about Station 6+30, downstream to about Station 9+00. From Station 9+00 to the upstream portal at Station 10+40 the excavation exposed bedrock. Random II engineered fill was placed on the exposed foundation at the apron, intake structure and along the Cut-and-Cover Conduit. The upper alluvium was left in-place over most of the upstream two-thirds of the foundation for the Random I fill which covers the Cut-and-Cover Conduit. Bedrock was exposed in most of the downstream one-third of the Random I foundation (Photos CC2 and CC4).

Before excavating to foundation grade in the area discussed above, the Contractor excavated a trench through the alluvium upstream and backfilled it with clay in an attempt to control groundwater. Also, dewatering ditches were excavated to drain groundwater away from the foundations. Patches of saturated foundation required the use of bridging layers in the area of the apron and the intake structure. Boulders, cobbles and gravel were placed in the dewatering ditches and at large springs near Stations 9+00 to 9+40 (Photo CC3). This facilitated placing and adequately compacting the Random I and Random II fills.

5.3.3 Tunnel - Excavation, Support, and Geologic Conditions Encountered.

5.3.3.1 Excavation and Support. Patrick Harrison Mining Company, the tunnel excavation sub-contractor, began excavation of the tunnel on 4 December 1989. The entire tunnel and ECC were excavated by conventional drill-and-blast techniques. Initial support for the downstream adit and the upstream tunnel consisted of horseshoe-shaped steel sets, wire mesh and shotcrete. The ECC initial support consisted of resin grouted and tensioned anchors in combination with wire mesh and shotcrete. After placing the concrete lining, the upstream tunnel, the ECC, and the upstream part of the downstream adit were contact and consolidation grouted. The adit downstream of Station 19+50 was contact grouted only. The tunnel grouting is discussed in more detail in Section 6.2. Excavation was started at the downstream portal (Photos T1 and T2) and proceeded upstream from this heading until 1 May 1990 when a second heading was begun at the upstream portal. The two headings met at outlet works Station 11+20. A temporary pilot hole was excavated through the ECC location. The ECC excavation was expanded to the full dimensions after the excavation of the upstream tunnel and the downstream adit were completed. The downstream adit was excavated to a nominal height of 11.75 feet. The crown radius was specified at 6.5 feet to the "B" line (pay line for excavation and concrete lining payment). Below springline, which was located at 5.0 feet above invert, the walls were vertical. At the time of this writing, overbreak beyond these dimensions is expected to be the subject of litigation between the Contractor and

the Government. Substantial overruns in the concrete quantities occurred. At numerous times during construction it was noted by the Corps' geotechnical staff that the Contractor left the excavation unsupported for as much as 78 feet. This practice undoubtedly resulted in stress relief and ravelling of the rock. Also, it was occasionally noted that the angle at which blast holes were drilled extended outside the excavation limits and caused excessive overbreak.

Spiling bars were placed parallel to the tunnel alignment at both portals to pre-support the tunnel before excavation was begun. Centralized No. 11 bars were placed in holes drilled 20 feet deep and inclined upward at about 3 degrees from the tunnel alignment. The annulus around the bars was filled with Portland cement grout. The first four portal sets at the downstream portal were placed at a spacing of 2 feet. Due to the angle at which the tunnel intersects the portal face this resulted in a canopy extending out from the excavation on the north side but flush with the portal on the south side. A canopy of sets at 2-foot-spacing was also constructed at the upstream portal.

It was the intent of the specifications that sets be placed in the downstream adit at spacing dictated by conditions as observed during excavation. The Contractor interpreted the drawings to say the sets would be placed at a pre-determined spacing of 3 feet. Extensometer readings, observations of rock conditions, and the reaction of the blocking behind sets indicated to the Corps' geotechnical staff that the spacing could be relaxed along much of the excavation. The Contractor initially refused to change the spacing unless the Government paid him for all the spacer bars he had pre-cut for 3-foot set spacings. He later became convinced that it was in his interest to increase the spacing in order to speed-up the rate at which the tunnel excavation was advanced. The set spacing was changed to 4 feet at Station 15+96 (after the 348th set placed from the downstream portal). Steel sets were placed on a 4-foot spacing throughout the upstream tunnel.

Split-sets and tunnel straps (Photo T9) were used on an as-needed basis in the temporary pilot hole through the ECC. The Contractor elected to use split-sets and tunnel straps in parts of the adit and upstream tunnel as initial support to allow more time before steel sets were placed. This procedure was not used extensively until after the problems (see Section 5.3.3.2) at the Set 263 fault were encountered. Split-sets were placed in areas of the downstream tunnel where the Contractor thought they were advisable before sets were installed. Throughout the project, short split-sets were used to hang the wire mesh before shotcreting.

In the ECC, initial support consisted of Williams No. 10 deformed bars epoxy grouted into 1.75-inch-diameter percussion holes drilled 20 feet into rock. These were used in combination with shotcrete and wire mesh. Lines of anchors were spaced at 3 feet and the spacing between anchors on each line was generally 6 feet, staggered from the preceding line.

The majority of the blast holes were drilled with a two-boom jumbo (Photos T3, E7 and E8). Jackleg drills and a single-boom jumbo were also used. Load-haul-dump (LHD) (Photos E5 and E6), also called mucking machines, were used to pick up the blasted material and transport it out of the tunnel. The jumbos and the LHDs were rubber-tired equipment which deteriorated the tunnel invert where it consisted of softer rock and especially when water was not controlled. The two-boom jumbo and a large scissor lift were used to install rock anchors in the ECC (Photos T20 and T21). Steel sets were hauled into the tunnel on the buckets of the LHDs.

Shotcrete equipment was set up at the portals for each sequence of applying shotcrete in the tunnel. The low moisture content shotcrete was generally delivered in ready mix trucks, dumped into the shotcrete "pot" at the portal, then transported by air through metal piping to near the location in the tunnel where the shotcrete was to be applied. A flexible line and handheld nozzle were then used to apply the shotcrete.

5.3.3.2 Geologic Conditions Encountered. The tunnel excavation was begun at the downstream portal where the Kelvin Formation beds strike nearly perpendicular to the centerline of the tunnel. The tunnel alignment curves at two locations within the left abutment so that at the upstream portal the alignment nearly parallels the strike of bedding in the Frontier Formation. Much of the rock encountered during the excavation was moderately to highly fractured as was expected based on explorations. However, the geologic conditions encountered were, in general, better than anticipated. The fractures were tight in many cases, and this apparently resulted in better stand-up time than anticipated. Throughout most of the tunnel and ECC, instrumentation showed very little deflection of the support system indicating that loads were less than expected. The lack of deformation of the wood blocking behind the sets was also an indication that little load was being supported by the sets. Also, slaking was not severe, probably because the surfaces were not exposed to weather conditions in the same way as the rock outside the tunnel. Three problem areas occurred where the conditions were notably worse than the average conditions within the tunnel. These conditions had been observed in the explorations but, since the orientations of the features which caused the problems were not known with certainty, the exact locations at which they would be encountered could not be determined.

A soft, weak, altered bed (referred to in field notes as Parsoneault's Soapstone) was exposed at the downstream portal face above the tunnel excavation. The bed dipped in the direction of the tunnel excavation and was also encountered at about Station 26+21 in the tunnel. Stand-up time in this material was very short. Small slabs of the material ravelled onto the crew as they installed the sets and wire mesh. The invert of the excavation deteriorated rapidly from about Stations 26+32 to 26+02. The fact that the Contractor did not control water significantly contributed to the problem. The Contractor continued the operation of rubber-tired equipment through the area as the excavation was advanced and as a result, the invert was degraded to the point that the elevation was as great as 18 inches below the foundation for the support sets (Photo T24). Extensometer

instrumentation was installed on a support set at Station 26+16, within the weak rock zone. Small, continuous deflections were noted in the extensometer readings. The Contractor was directed to place a concrete "mud" slab to stabilize the invert and to prevent further deflections of the sets. The foundation was cleaned and the slab was placed from the portal, upstream to Station 26+02, a distance of 30 feet. The weak bed encountered at Station 26+21 was encountered in exploration core hole 1F-4.

The most difficult conditions encountered in the tunnel were at the Set 263 fault (Photo T16) which extended from about Station 19+50 to Station 17+00 (as the tunnel was advanced in the upstream direction). A large overbreak occurred at an area of shearing and heavy flows of water came from the crown near Station 19+30. A void exceeding 6 feet extended up into the crown and required substantial wood blocking utilizing the "log cabin" technique (Photos T11 through T13). As the tunnel was advanced upstream, soft, sheared and brecciated rock was encountered. Refer to Plates 36 thru 38 for the geologic maps of this area of the tunnel. The tunneling contractor had failed to follow guidance provided by the Government which stated that the initial support system should be maintained at no greater than 20 feet back from the heading. Sets had been placed at the proper spacing to within about 17 feet of the face, which was at Station 18+57, but had not been blocked between the sets and the walls of the excavation. The Contractor could not block behind the sets because he had run out of wood blocking. In reality, the tunnel was unsupported for 64 feet back from the face at the end of the work week on Friday, March 2 1990. The Contractor did not work Saturday or Sunday. The 17 feet of unsupported tunnel was in weak material which produced substantial water. Ravelling was occurring over the south half of the excavation as of the morning of March 3. The Contractor's crews returned to work on Monday, March 6, and began mucking and applying shotcrete downstream of the ravelling area. A load of wood for blocking was delivered at about 1130 hrs. The crews worked at blocking, lagging, and applying shotcrete in the ravelling area. The ravelling created a void that extended a maximum of 16 feet out from the south springline between Stations 18+57 and 18+75. The Contractor used extensive wood lagging and shotcrete to temporarily stabilize the area. Later, additional shotcrete was applied to the void area which effectively stabilized the area (Photos T14 and T15). The Contractor then proceeded with the excavation in a more conservative manner. The excavation was pre-supported by the installation of No. 10 spiling bars; short advances (3 feet) were blasted; and a set was installed immediately after excavating each round. These procedures were followed until the geologic conditions permitted discontinuing spiling and the shorter rounds. This occurred near Station 17+70.

Several extensometers were installed in the weaker parts of the Set 263 fault zone. The instruments indicated that the legs of the sets were deflecting toward the center of the tunnel under squeezing loads from the sides of the excavation. An attempt was made to stabilize the sets by installing 6-foot-deep split-sets and tie-back straps at the bottom of the sets. This was unsuccessful and the sets continued to deflect. The Contractor was then directed to place a concrete "mud" slab at the tunnel invert from Station 18+32 to

Station 18+92. This stabilized the sets. The End of Construction Report on Project Instrumentation contains these instrument readings. The poor rock conditions seen in exploratory core holes 1F-98 and 1F-99 indicated the need for prompt initial support in that area of the tunnel. The orientation of the feature which caused the poor rock conditions was not known, however it was reasonable to assume that conditions would project to the tunnel at some location.

Another problem area was encountered at the upstream end of the ECC, near Station 13+62. A shear zone was identified during explorations and it was expected that the shear might project to this location within the ECC. Mapping of the pilot excavation confirmed the location of the shear and gave indications that it might cause problems when the ECC was excavated to the full dimensions. The Government suggested that the area of the larger shear at the upstream south corner be pre-supported with spilling and that shorter rounds be blasted in that area. Also, shotcrete was applied in a more timely manner in the area. No significant problems occurred after these precautions were taken.

Groundwater was encountered at numerous locations along the tunnel alignment as shown by the spring symbols on the geologic maps. At one time during the excavation, a total flow of about 30 gpm was measured at the downstream portal. The groundwater and drill water produced by the drilling equipment, in combination with the Contractor's failure to provide adequate control of the water and the traffic of the rubber-tired equipment, caused serious deterioration of the tunnel invert where the rock was relatively soft. These factors resulted in a potential for a large overrun in concrete when the lining was placed. The Contractor requested a variance to backfill the overexcavation in the invert with gravel.

The following variance was allowed.

a. Zone I, defined as the reach between Stations 16+86 and 17+86, was constructed as per the plans and specifications. No variance was allowed.

b. Zone II, defined as the reach from Station 13+00 to Station 19+50, exclusive of Zone I was filled with crushed stone meeting the requirements of Drainfill I, a clean gravel, between firm undisturbed foundation and the "B" line. The Contractor was directed to place the gravel in 8-inch-thick loose lifts and compact with 6 passes of a 10-ton drum roller operating in static mode. However, the contractor never used the specified roller and all areas were compacted with hand compaction equipment. An additional invert grout port was installed between the basic contact grout rings to insure full consolidation grouting of the drain fill material.

c. Zone III was defined as the area between the portals and the Zone II areas (Stations 10+40 to 13+00 and 19+50 to 26+32). Here the invert was filled with Drainfill I and Drainfill II material between the undisturbed foundation and the "B" line.

The gravel was compacted as described above. Additional grout ports were not required. However, concrete cutoffs were placed to foundation rock on approximately 100-foot spacings.

After placing the tunnel lining it was necessary to grout the gravel in the invert before drilling and grouting consolidation grout holes. This became necessary because the loose gravel caved into the grout holes when the drill rods were removed.

5.3.4 Downstream Portal, Downstream Operational Control Structure (DOCS), Wing Walls, Plunge Pool and Discharge Channel Sill.

5.3.4.1 Downstream Portal. The excavation for the downstream portal varied from the plans and specifications partly because of a preliminary excavation done by the Contractor to provide access for drilling equipment to install two inclinometers. The initial excavation resulted in the cut-slope extending outside the designed limits. This required additional anchors at the top of the cut-slope and, in combination with inadequate survey control, caused the excavation to be outside designed limits for some distance below the instrumentation benches. Excavation at the downstream portal was accomplished with conventional equipment including large trackhoes and dozers. No blasting was required. Refer to Plate 6 for the drawing of the portal.

Plate 44 shows the Downstream Portal Geologic Map. The upper part of the portal excavation was in slopewash and residual soil (Photo P6). Bedrock of the Kelvin Formation was encountered several feet above the bench at Elevation 5610 feet. The middle portions of the excavation were in rock below that elevation. The upstream and downstream portions encountered slopewash, residual soil and a cobbley lens of the Older Alluvium.

A weak bedrock layer (referred to as Parsoneault's Soapstone in field records) was encountered in the vertical cut at about Elevation 5595 feet. This occurred about 20 feet downstream of the tunnel and in the middle elevations of an 18-foot-high section that was unsupported. A slope failure, about 20 feet long by 10 feet high and 5 to 10 feet deep, occurred in the soft rock layer, involving approximately 40 cubic yards of material. Photo P17 shows the affected area. An additional 11 anchors were placed in this unstable soft rock and a thick layer of shotcrete was applied.

A smaller failure occurred at Station XXX along a clay-filled fracture which dipped out of the face at the top of the tunnel and extended downstream about 15 feet. The failure resulted in a void of about 15 feet long by 4 feet deep and 4 feet high. The adverse orientation of the fracture along which the failure occurred appeared to exist at other locations downstream of the tunnel. A thick layer of shotcrete was applied at the void, and seven near-vertical anchors were installed in the area where adverse fracture orientations were expected as the excavation went deeper. The anchors were installed

at about 5 degrees from vertical to pre-support the vertical excavation. No further problems occurred.

5.3.4.2 Downstream Operational Control Structure (DOCS). Foundation materials encountered at the downstream outlet works structures are shown on Plate 45. The DOCS was founded on firm siltstone, sandstone and claystone of the Kelvin Formation and should experience no problems. At the upstream half of the building, the foundation was thoroughly cleaned of all loose or unsuitable material and a concrete "mud" slab was placed to prevent deterioration of the soft rock. No further foundation treatment was required. At the downstream part of the foundation, bedrock was several feet below the floor elevation but the footing walls were founded on bedrock. Soil backfill was originally planned between the foundation and the floor of the DOCS at this location. The Contractor requested a variance to use concrete because of the difficulties of placing and adequately compacting soil in the confined space. The variance was granted and the concrete was placed on firm Kelvin Formation material.

5.3.4.3 Wing Walls. For the most part, the wing wall excavations exposed firm bedrock of the Kelvin Formation. A small corner of the first wall north of the DOCS was founded on firm alluvium as was most of the second wall north of the DOCS. Excavation at the location of the north wall revealed unsuitable material consisting of organics and debris from the portal excavation. The excavation was taken approximately 8 feet below the bottom of the footing to expose firm bedrock. Bedrock was exposed in the excavation of the three wing walls south of the DOCS. Saturation of the soft bedrock by groundwater seeping into the excavation caused repeated deterioration at the north-east corner of the first wall south of the DOCS. Repeated removal of the deteriorated material resulted in several feet of overexcavation at this location. Where necessary, the foundations for the wing walls were brought up to final grade with clean gravel (Drain Fill). This was required at all the wing wall foundations. Several feet of fill was required at the northeast end of the first wall south of the DOCS. In excess of 8 feet of fill was required at the north wing wall. The foundation excavations exposed good foundations at the final elevations in all cases and all loose or unsuitable material was removed. Any small deflections which occur would most likely be attributable to the granular fill placed under the wall footings. A slight deflection occurred at the contact between the first and second walls south of the DOCS after placement, however this probably resulted from the compaction of fill behind the walls. The offset is being monitored as part of the periodic inspections.

A slope stability problem was encountered while excavating for the wing wall south of the DOCS. A failure occurred in the steep wall cut into soft bedrock. The Contractor proposed a fix which utilized wood cribbing and tie-back anchors (Photo D3). The system was adopted and was effective in stabilizing the slope.

5.3.4.4 Plunge Pool. The upper half of the plunge pool was excavated through granular deposits of the Younger Alluvium. The lower half of the excavation

encountered bedrock of the Kelvin Formation. Most of the excavation was done with conventional equipment, however the lower portions encountered hard sandstone layers which could not be ripped by dozers. Blasting was required in two instances to complete the excavation (Photo D1).

5.3.4.5 Discharge Channel Sill. The discharge channel sill excavation exposed granular deposits of the Younger Alluvium. The sill was formed and placed in a trench excavated into noncohesive gravel, cobbles and boulders.

5.4 Spillway. The spillway cut follows a small saddle about 300 feet northwest of the right end of the dam. As seen on the Spillway Geologic Map, Plate 46, the middle part of the cut exposed bedrock of the Kelvin Formation at invert level. Thin overburden covers bedrock at the upstream and downstream ends of the cut. The concrete sill was founded on firm bedrock. Numerous shears were mapped in the spillway cut. Bedding plane shearing was extensive along two weak, altered claystone beds trending subparallel to the spillway centerline and several small displacement shears were also seen to cross bedding. There was no evidence of recent activity along any of the shears and they pose no threat to the structure. Minor problems resulted from groundwater seeping out of the foundation along shears at the lower right cut-slope. The water contributed to rapid deterioration of the bedrock foundation. The Contractor requested that he be allowed to place a concrete "mud" mat over most of the right side of the sill foundation to protect the foundation while the sill was formed. This was allowed and the technique resulted in good foundation conditions for the sill.

All of the erosion control structures (ECS) were founded on bedrock after excavating through slopewash, residual soil and Older Alluvium. For the most part, the excavation for these concrete-filled trenches extended to about 20 feet deep. However, as seen on the trench logs, Plates 48 and 49, bedrock was encountered higher in some locations and the bottoms of those structures were shallower than designed. A problem occurred at ECS-E when groundwater was encountered in the excavation. The middle portions of the trench caved in before concrete could be placed. This resulted in the placement being made in two phases and caused the middle section of the structure to be thicker than designed. This should not cause any reduction in the performance of the structure.

5.5 Parley's Creek Diversion Structure. Plate 50, Geologic Map of Parley's Creek Diversion Structure, shows the foundation geology at the Parley's Creek Diversion Structure and Spillway. Originally, excavation was planned to remove weak clayey materials and expose dense, cobbley alluvium. Engineered backfill was planned to bring the foundation back to grade for the concrete structures. At the left side of the excavation, where the Spillway was to be placed, this was substantially the case, although some soft spots were revealed by proof-rolling and were removed. The upstream right side of the excavation encountered dense alluvium as expected, and some bedrock. Groundwater caused serious problems at the downstream right part of the foundation (Photo PC2). This area was the foundation for the downstream part of the diversion

structure. A thin, soft clay layer was encountered at about foundation level and was removed. Due to the Contractor's inability to handle groundwater, however, the foundation continued to deteriorate and substantial overexcavation resulted. Bedrock was eventually exposed at this location (Photo PC3). A free draining cobbley fill was placed in the low area which contained several feet of standing water (Photo PC4). Several feet of engineered fill, consisting of relatively clean gravel, was placed over the entire Spillway and Diversion Structure foundation to bring the elevation up to grade for the concrete structures.

During excavation and construction, creek flows were diverted in a 24-inch-diameter CMP along the left abutment. Substantial groundwater was encountered above foundation level in the excavation. The Contractor attempted to control the water with peripheral ditches and sumps consisting of perforated CMP and gravel placed in backhoe pits. This was successful except at the downstream right part of the excavation as described above.

6. GROUTING

6.1 Foundation Grout Curtain

6.1.1 General. The foundation grout curtain generally consists of three grout lines at 10 to 15 feet upstream of the dam axis. Some individual holes were drilled and grouted at locations off the alignment of the three main lines but within the core trench. Although some were not at a common offset they were assigned to the fourth line. The upstream line is labeled the "A" line, the downstream line the "B" line and the middle line the "C" line. All other holes were assigned to the "D" line. A map showing the location and pattern of the grout holes is included as Plates 83 through 90 and depict the grout leaks and communication between grout holes. The actual path followed by the grout was not known, only the exit points could be observed and are represented by the tips of the arrows. Plates 51 through 69 show the inclinations of the grout holes. In general, to cross the steeply dipping bedding, holes at the middle and right portions of the dam were inclined to the right at 60 degrees from horizontal. The holes were fanned near the top of dam to provide better coverage of the more brittle beds which strike at high angles to the dam axis. Holes at the lower portion of the left abutment were vertical, then fanned to inclinations as flat as 41 degrees from horizontal higher on the abutment. During design, flow net analysis indicated a highly effective cut-off was required to 75 feet deep. Below this depth the grout curtain was exploratory in nature and the main purpose was to obtain the benefit of reducing the permeability through larger fractures and to identify and grout any large cavities. For this purpose, the center grout line was installed to depths of 150 feet in most areas and to 220 feet deep where it tied into the tunnel grout holes within the left abutment. The amount of grout injected (grout take) in each hole is shown on the grout section drawings, Plates 51 through 69 and in the Detailed Summary of Foundation Grouting, Table 6. This table also summarizes the drilling and water pressure test data. The grout curtain was constructed primarily of Portland cement and water with small percentages of bentonite. Minor amounts of sand were also used.

The variable geologic conditions, as described in the Site Geology section of this report, resulted in highly variable grout takes. The following table presents a broad summary of the foundation grouting.

Table 2

General Summary of Foundation Grouting

Total Linear Feet of Grout Holes Drilled	Total Grout Injected (Sacks)	Average Sacks Injected Per Foot Drilled
74,526	27,855.8	0.37

Average of Ten High Ke Tests (Estimated Permeability)	Average Grout Take for Ten High Ke Stages
79.49 feet per day	0.42 sacks per Foot

Average of Ten Median Ke Tests	Average Grout Take for Ten Median Ke Tests
0.28 feet per day	0.08 sacks per Foot

Note: Ke is the estimated coefficient of permeability. Ten High Ke tests include tests where no pressure was obtained on the water pressure test gage. The results for these tests assume the hole was filled with water, which may not have been the case, and represent a minimum possible value.

In general, the degree to which the foundation was sealed by the grouting can be seen from the reduction in grout takes and Ke values as grouting proceeded from primary to split-spaced holes and from upstream line "A line" to downstream line "B line" then to the centerline "C line". The fourth line, "D line", would not fit the pattern since it was used to address anomalous conditions such as large surface fractures and the extension of the grout curtain at the upper left abutment.

Table 3
Average Grout Takes

Take per Foot/Ke
(Sacks per Foot/ Feet per Day)

	Primary	Secondary	Tertiary	Quaternary (and closer)
Zone 1 and 2				
Line A	.91/1.45	.52/1.94	.25/1.00	.13/3.54
Line B	.13/1.98	.16/.66	.41/2.13	--------
Line C	.09/.61	.03/.83	.09/.55	.12/5.50
Zone 3				
Line C	.76/.45	.82/.83	2.08/1.91	.95/.93

The Core Trench Grout travel map (Plates 83 through 90), the Foundation Grout Curtain (Plates 51 through 69), Grout Take Versus Station (Plates 70 through 82), and the summary in Table 6 present the specific results of the foundation grouting. See paragraph 6.1.2, Relationships between Grout Takes, Geology and Foundation Areas, for further discussion.

6.1.1.1 Sub-contractor. The grouting sub-contractor for both the foundation grout curtain and the tunnel grouting was Boyles Brothers Drilling Company of Salt Lake City, Utah.

6.1.1.2 Deep Nipples versus Grout Cap. Relatively weak rock existed over large reaches of the bottom of the core trench. During the design phase of the project, it was determined that placing deep grout pipes (nipples) at the surface was more economical than installing a grout cap in these areas. The need for a grout cap was considered possible in more restricted areas and an optional bid item was provided in the contract for this possibility. The grout cap option was not utilized and deeper grout nipples were used exclusively for the weaker rock zones. The grout pipes in weaker rock areas were installed to depths of about 5.5 feet in most cases. After grouting was completed, the core trench was excavated to near the bottom of the nipples, and the resulting foundation was prepared for placement of impervious fill. In areas of stronger rock, nipples were generally placed to depths of 1 to 2 feet. After grouting, these nipples were patched with mortar and the portions above the foundation surface were cut off. Four-inch-diameter black iron pipe was used for all nipples on the grout curtain.

6.1.1.3 Equipment, Materials and Techniques. Two grout mixing plants were utilized by the Contractor. For most of the work at the valley and right side of the dam, a bulk plant utilizing a Ross 100 bulk supply system was used to measure (by

weight) and supply grouting solids to the mixing plant. The mixing plant used a high speed centrifugal shear pump and a mixing tank configured to produce a vortex effect to produce colloidal mixtures. The plant used for the upper part of the left abutment was a shop-fabricated mixer built by Boyles Brothers. The mixing tank was a semi-circular drum with paddles on a horizontal shaft. A high speed coldcrete mixing pump turning at 1750 revolutions per minute (RPM) recirculated the mix. Holding (agitating) tanks of 20 cubic feet capacity were used at the mixing plants and at intermediate locations between the mixing plants and the grout holes (Photo E17). Pressure grouting was accomplished with Robbins Meyers 3L10 Moyno pumps capable of 100 gallons per minute at 300 psi (pounds per square inch). Grout holes were drilled with Joy Ram air tracks, Model Number MS4, and an Ingersol Rand air track, Model ECM351 Extendaboom. The top drive percussion drills used "NX" size percussion bits and "A" rods. Water was used as the drilling fluid. Type II Portland cement used for grouting was supplied to Boyles Brothers by Ideal Basic Industries, Cement Division. Fluidrill Mud Systems supplied pure sodium bentonite with no additives.

Little Dell was the first project on which the Corps of Engineers used handheld computers to collect grouting data in the field then transfer this data to dBase III+ databases stored in personal computers (PCs) at the Resident Office. Although dBase programs written by Waterways Experiment Station (WES) were used at previous Corps grouting projects, development of the software necessary to collect, store, and manipulate the data to produce reports and graphics continued throughout the Little Dell Lake project construction. The data was entered into Corvallis Microtechnogy MC-V handheld computers by Corps of Engineers inspectors at the grout curtain. (The inspectors also kept hand-written records in notebooks.) Using RS-232 cables and commercially available communications software (Kermit), the data was downloaded to a Compaq Deskpro 286 PC with a 20 megabyte hard drive at the Resident Office. Use of the computer for other purposes later required upgrading the hard disc to 40 megabytes, but when editing the databases and building plot files the 286 was still too slow to be practical. A Dell 486 was used during the preparation of the foundation report to correct the databases and generate the plots. An Epson LQ 1050 dot matrix printer was used to print reports and a Hewlett Packard 7550A 8-pen plotter was used to generate the color plots. The handheld computers were procured by Sacramento District's Construction Operations Division at the beginning of the Dam and Appurtenances contact. The Compaq 286 computer, dot matrix printer and pen plotter were required by the contract and supplied by the prime contractor. The Dell 486 computer was supplied by the Sacramento District. The additional speed of the 486 made it possible to edit the data and draw plates for the report in a timely manner.

The grout curtain work was begun in September of 1989. Because the Contractor had determined he could not place embankment to the elevation required by the contract for the following spring season, he elected to build a notched embankment. This plan would have begun the embankment at the bottom of the right abutment and extended to the right and it would have left a temporary notch at the original stream location which would be

filled-in by later work. For this reason, the grout curtain was not begun at the lowest part of the core trench foundation. Grouting was begun at Station 16+85 and proceeded to the right. The Contractor later changed his overall plan and the dam was not constructed as described above. The sequence of the grouting can be seen by the dates contained in Table 6.

For a given section of the grout curtain the upstream line was completed first, the downstream line was completed second and the middle line was completed last. A modified "stage down" grouting technique was employed. In general, the procedure was as follows:

1) Zone 1 was drilled, water pressure tested (WPT) and grouted
2) After about 24 hours, the grout in Zone 1 was drilled out (re-drilled)
3) Zone 2 was drilled, WPT and grouted
4) The same procedure was then followed for Zone 3.

Initially, 10 psi was applied to the 5.5-foot-deep nipples. However, shortly after the grouting program began, pressures of 1 psi per foot of depth to the packer was used as a rule of thumb. In many cases during grouting of the first zone, grout leaks occurred which caused a loss of pressure and required rapid thickening of the grout mix. This had the effect of reducing the duration of the allowable pressure in the lower zones, and premature thickening of the mix. For this reason the stage-down method was modified over much of the valley and right abutment reaches of the grout curtain. The modified technique would place a packer at about 15 feet down the hole where 15 psi could be used. This reduced rapid surface leaks. After the deeper part of Zone 1 was grouted to refusal, the packer was raised (or the nipple was connected) and the higher portion of Zone 1 was grouted to refusal using the lower allowable pressure. Under the standard stage-down method subsequent zones would be grouted from the nipple with higher allowable pressures. Again, where the rock was weaker, at the middle and right sides of the dam, surface leaks occurred quickly and pressure could not be maintained. The standard method was modified to place a packer at the bottom of the first zone and allowable pressures were reduced to the column pressure plus 30 pounds of gage pressure.

Circuit grouting was employed on a very limited basis at the left abutment in holes C13+00 thru C13+15. This was done to address subsurface conditions where severe caving problems were encountered in an area of potentially large open fractures. The circuit grouting technique involved the following steps.

1) The hole was drilled to a predetermined depth or until the hole could not be kept open.

2) The drill rods were removed and a grout pipe with hard-facing on the beveled bottom end was "washed and chopped" back to the drilled depth.

3) A box with a packing gland around the top of the grout pipe, valves, and a pressure gage was installed at the nipple. A grout line was connected to the top of the grout pipe and grout was injected until grout returned to the top of the hole through the annulus between the grout pipe and the wall of the hole. The valves on the packing box were adjusted to maintain the required grouting pressure while assuring grout was being circulated from the bottom to the top of the hole.

Split-spacing criteria varied according to several variables and was subject to modification according to the judgement of the Project Geologist (or the judgement of the full-time grout inspectors with the concurrence of the Project Geologist). Closure was evaluated on the basis of grout take. Closure was attained when holes took only the amount of grout slurry required to fill the holes. In the upper two zones, the upstream and downstream lines were intended to confine the middle line, then closure would be attained on the middle line. The upstream line was automatically split-spaced down to 5-foot-spacings, regardless of take. Since the downstream and middle lines split-spaced the upstream line tertiary holes only 5.0 feet and 2.5 feet downstream respectively, the upstream line was split-spaced only when geologic information or other observations indicated significant fractures might be missed by the subsequent lines. Absolute closure was not required in all cases for the upstream and downstream lines, although, with few exceptions closure was attained. Closure was attained on the middle line, Zones I and II, with the exception of several holes in the middle of the dam where moderate grout takes were attributable to surface leaks.

6.1.2. Relationships between Grout Takes, Geology and Foundation Areas. The plates and tables discussed in Paragraph 6.1.1 give specific information about grout takes and water pressure tests. The following summarizes the results of the foundation grouting in general terms:

1) Grout takes varied greatly over small distances as was expected based on geology. This supported the rationale whereby the upstream line was automatically split-spaced down to 5-foot-spacings regardless of takes.

2) The Zone II and III holes at the upper left abutment consistently took large quantities of grout and required frequent staging because of drill water losses. These larger takes are believed to be related to fracturing near the Left Abutment fault in substantial thicknesses of the more brittle rock. The left abutment, in general, had the highest grout takes on the grout curtain. Hole A1305 took 648.9 sacks (in all zones), the highest take per hole on the project. Exploratory core hole 1F-104 was drilled in this area and indicated the conglomerate bed was intensely fractured, with some grout-filled fractures to 1/2-inch-wide. Fracture widths of 1-inch were common where the conglomerate and nearby hard sandstone beds were observed at the core trench foundation. The drilling of grout holes and 1F-104 indicated severe caving at depth in this area, probably resulting from the intense fracturing along the Left Abutment fault. Circuit grouting of four middle line holes was used to assure that no large, open fractures were left ungrouted in the area near Station 13+00.

3) The right abutment, right of Station 23+00, was generally the tightest part of the foundation, considering all zones.

4) Between Stations 14+50 and 19+25, few holes had large grout takes in the top two zones. It is notable that in this area substantial takes occurred in Zone III where rock types should have been the same as in the upper two zones. This may be because the lower sections were below the water table and this resulted in less softening and clay filling along the fractures at the lower elevations. Also, more pressure was used when pressure washing and grouting the lower zone.

5) Larger takes were common in the top two zones between Stations 19+25 and 23+00. Large open fractures were observable at the surface in thin, hard sandstone beds in this area.

6) In general, the harder, more brittle sandstone and conglomerate areas took the highest quantities of grout. In the areas where higher percentages of siltstone, claystone and altered beds occurred, the grout takes were lower. Exceptions occurred where areas of predominantly softer rock types contained narrow beds of hard brittle sandstone with large open fractures.

7) Incidents of grout surface leaks were conspicuously higher in the valley bottom near the location over which Dell Creek flowed before the project was begun. Much of the grout injected in this area was thinner mixes. This may have been caused by the fact that smaller fractures were cleaner because of the flow of surface and groundwater through the area.

6.2 Tunnel Grouting

6.2.1 General. After installing the concrete tunnel lining, contact grouting was done in the crown throughout the entire length of the tunnel and ECC, and consolidation grouting was done from the upstream end of the tunnel down to Station 19+49 (Photo T26). The specifications originally called for the consolidation grouting to be discontinued at about Station 17+36. However, because of problems encountered at the Set 263 fault zone, consolidation grouting was continued down to Station 19+49. Grout hole arrays, grout travel and ranges of grout takes are shown on the tunnel grouting maps, Plates 94 through 107. Quantities are shown in Table 7, Detailed Summary of Drilling and Grouting in Tunnel.

In general, the tunnel grouting program was successful and resulted in only minor changes to the contract, specifically the changes required at leaking grout nipples (discussed in the last paragraph of 6.2.1.3 below). Minor seepage through shrinkage cracks and around some grout hole patches continues, however this is not unusual for concrete linings subjected to hydraulic pressures. Corrective action in the form of epoxy grouting of the cracks is now being considered. No distress related to uneven or

excessive loads has been observed. Seepage into the tunnel, as measured in the collection ditch at the downstream end of the outlet works, was about .003 cfs (1.35 gpm) in October 1993.

Table 4
General Summary of Drilling and Grouting in Tunnel

	Upstream Tunnel	ECC	Downstream Tunnel	Total
Drilling (feet)				
Contact	1658	347	2657	4662
Consolidation	3093	3928	10338	17359
Grout Take (sacks)				
Contact	1083	1403	3691	6177
Consolidation	1460	653	3023	5136
Sand in Grout (cubic feet)		288		
Grout per Foot of Consolidation Drilling - Average (sacks/foot)	.47	.17	.29	.30

6.2.1.1 Sub-contractor. Boyles Brothers Drilling Company of Salt Lake City, Utah was the grouting sub-contractor for both the foundation grout curtain and the tunnel grouting.

6.2.1.2 Nipples. Two-inch-diameter black iron pipe was used for grout pipes (nipples) and was installed in the reinforcing steel before placing the concrete lining. The holes required by the plans and specifications were marked by the Contractor. This array was then inspected by the Resident Office Geotechnical staff and additional nipples were added where necessary. The nipples were fastened to the rebar with wire, and styrofoam plugs were placed inside the end of the pipe. The Contractor placed tape over the outside end of the nipples, however some of the nipples were completely or partially filled with grout when the lining was placed. After placing the lining it was often difficult to relocate the grout nipples. Some nipples could not be found and a limited amount of diamond core drilling was required to replace them. A few holes that could not be found were not replaced because it was judged that the grouting was adequate and coring would risk unnecessary cutting of reinforcing steel.

6.2.1.3 Equipment, Materials and Techniques. For the most part, grout placed in the tunnel consisting of cement, water, and bentonite. Sand was used during the contact grouting of the ECC crown. Also small amounts of High Range Water

Reducer (HRWR) were used when grouting the gravel under the lining invert downstream of the ECC. Refer to Tunnel Geologic Conditions Encountered, Section 5.3.3.2, for a discussion of this gravel. A high speed colloidal grout mixer, consisting of a mixing tank and an agitating tank fabricated by Boyles Brothers, was placed at the tunnel portals. The mixing tank was a semi-circular drum with paddles on a horizontal shaft. A high speed Coldcrete mixing pump turning at 1750 revolutions per minute (RPM) recirculated the mix. Pressure grouting was accomplished with Robbins Meyers 3L10 Moyno pumps capable of 100 gallons per minute at 300 psi. Agitating tanks were spaced along the tunnel as required. Contact drilling and shallow consolidation drilling were done with jackleg drills. Deeper consolidation drilling was done with a track-mounted or post-mounted rotary drill (Photo T25). All drilling and grouting equipment was operated by air from compressors placed at the portals.

Contact drilling and grouting were begun at the upstream portal and proceeded downstream. When the contact operation was sufficiently advanced so that drill water from the consolidation hole drilling would not affect the fresh contact grout and travel from contact grouting would not plug consolidation holes, consolidation drilling and grouting was begun. The contact grout in the nipple was either washed out after initial set or drilled out after hardening, at the Contractor's option. Consolidation holes were generally drilled to depths of 10 feet from the inside of the liner and into the surrounding rock, except at the ECC, the grout curtain intersection, and the Set 263 fault. At the ECC, the consolidation holes were drilled 30 feet out from the inside of the liner. At the grout curtain intersection the holes were drilled 50 feet deep and at the fault they were drilled 30 feet deep. The depths of individual holes are shown in Table 7, Summary of Tunnel Grouting. Consolidation grouting was begun at the upstream portal and proceeded downstream, except in the area from Station 16+97 to 19+49 where a pre-determined split-spacing technique was employed. Alternating rings were drilled and grouted as Primary, Secondary, and Tertiary rings, regardless of grout takes. Where this was done the grout maps show the primary rings labeled "A", secondary rings labeled "B" and tertiary rings labeled "C". All consolidation drilling was done as one zone. Grout mixes of 1:1 (W:C) ratio with 1 percent bentonite were used over most of the tunnel and adit for contact grouting. Sanded mixes and 0.9:1 (W:C) mixes were also used during contact grouting of the ECC. Consolidation grout mixes were started at 4:1 (W:C) with 1 percent bentonite and thickened based on take. Grouting pressures were generally 30 psi for contact grouting and 100 psi for consolidation grouting. Near the portals, pressures were restricted to 1-pound per foot of distance from the portals.

A problem resulted from the use of these thin mixes where holes were tight and thicker mixes were not injected. The thin mixes left only thin shells of grout at the bottom of the holes in the crown and essentially open holes in the invert. The invert holes were backfilled with thicker mixes since this did not require additional connections. The use of High Range Water Reducers and lower water content mixes should be considered in the future.

Where fine fractures existed in wet holes the seepage from the holes caused problems during patching of the grout nipples. Considerable effort was expended in patching the wet holes, and a change order was negotiated to provide techniques and materials not required by the specifications. In some cases, the Contractor installed small pipes in the nipples and packed lead wool around them before packing the nipples with water resistant grout. Lead wool was then driven into the small pipe and it was packed with the water resistant grout. In the majority of the cases of the leaking nipples, where threads were available, plugs were purchased and threaded into the ends of the nipples before patching with water resistant grout. These techniques greatly reduced the leaks at the nipples, however some seepage continues.

6.2.1.4 Grouting of Gravel Under the Tunnel Invert. Grouting of the gravel under the lining invert was required by the Corps in some reaches but not in others, depending on the probability of causing excessive losses from the reservoir. It was later determined that all of the reaches where consolidation grouting was required had to be contact grouted so that the consolidation grout holes would not be obstructed by the gravel. Locations where the gravel was grouted is shown on the tunnel grouting maps depicting contact grouting.

6.2.2 Grouting Results. The results of the grouting is detailed on the Plates 94 through 99, and in Table 7. A generalized summary is presented in Table 4, above. However, several locations warrant further discussion here.

6.2.2.1 Discussion of Grouting Results at Specific Locations:

a) At the upstream tunnel it was anticipated that contact grouting would be done in the crown only and that grouting rings would be on 10-foot-centers. However, after observing the intensely sheared and altered nature of the rock at the downstream part of the area (Stations 12+27 to 13+61), contact grouting was extended all the way around the tunnel and rings were located on 5-foot-centers.

b) The last two rings of the upstream tunnel closest to the ECC were not contact grouted because at this location the liner was placed concurrent with the upstream headwall of the ECC and it was thought highly unlikely that any void could exist above the liner. Consolidation grouting was performed here.

c) The most significant contact grout takes occurred at the upstream end of the ECC. Hole 13+61A took more than 900 sacks of grout. Grout travelled from this hole all the way to the downstream end of the ECC. Several other holes in the crown of the ECC took more than 100 sacks of grout.

d) No contact grouting was done in the invert between Stations 17+12 and 17+70 because the invert lining was placed on clean rock with no gravel. The same conditions existed at about Station 17+40 but the conservative approach was taken and contact

grouting was done here because the foundation grout curtain intersected the tunnel grouting at this location.

e) Contact grouting was not performed in the invert at about Station 18+35 because the "mud" slab at the Set 263 fault zone was placed in this area. Some confusion over the location of the slab apparently caused the contact grouting to be omitted in a zone that only partly coincided with the slab. No problems resulted from this omission, however, because the area was successfully grouted in the consolidation grouting sequence.

f) The Set 263 fault zone was encountered between Stations 17+00 and 19+50 and the gouge and breccia within the fault zone were encountered between Stations 18+30 and 18+90. The grouting program was adjusted to account for this. The consolidation grouting was extended to cover the area and the density and depth of holes were increased to provide appropriate coverage. It is notable that significant contact and consolidation grout was placed in the area of the fault zone.

g) The grout nipple at hole 13+43G was damaged during placing of the tunnel liner which required that the hole be replaced with a diamond cored hole. The cored hole penetrated the 6-inch-diameter steel air line encased in the right side of the liner. Due to a breakdown in Contractor/Corps communications the hole was connected on a different shift and considerable grout was pumped into the pipe. Considerable time and effort were expended by the Contractor before the grout was removed from the pipe and the pipe was repaired.

7. INSTRUMENTATION. Foundation instrumentation is discussed in detail in separate reports titled "End of Construction Report on Project Instrumentation, Little Dell Lake, Salt Lake City Streams, Utah" and "Embankment Criteria and Performance Report". These reports are on file in the Soil Design Section.

7.1 Embankment Foundation Instrumentation. Instruments installed in the embankment/foundation are summarized by the following table:

Table 5
Embankment/Foundation Instrumentation

Instrument Type	Contract Fdn	Contract Emb	Additional Fdn	Additional Emb	Instruments Lost Fdn	Instruments Lost Emb
Vibrating Wire Piezometers	31	40	4	2	2	0
Open Tube Piezometers	15	6	7	2*	4	0
Observation Wells	1	1	1	0	0	0
Survey Monuments	39		2		0	
Inclinometers	13		0		0	
Seepage Measuring Points	2		1		0	
Accelerograph Installations	5		0		0	

Note * Seven temporary open tube piezometers were installed in the cofferdam but were backfilled and were not extended above the top of the cofferdam.

7.2 Portal Instrumentation. Inclinometers were installed at both portals as excavation progressed. Inclinometers I-4 and I-5 were installed soon after the initial excavation at the downstream portal (Plate 44). I-4 was accidentally destroyed during construction. I-4A was installed to monitor the excavation of the vertical cut and I-4 was later replaced by I-4R. I-1 and I-2 were installed shortly after the initial excavation at the upstream slope (Plate 29). Two short inclinometers, I-3A and I-3B, were substituted for a longer inclinometer which was originally planned for the vertical cut at the upstream portal.

A potential wedge failure was identified at both portals based upon the inclinometer readings. In part due to inclinometer readings, additional anchors were installed in an unstable rock wedge at the upstream portal. The rock wedge was stabilized and was later covered by the cut-and-cover fill. At the downstream portal, some movement was observed in the vertical cut as the excavation approached the designed elevation. This movement was arrested by the addition of the remaining required anchors. In general, there is no cause for alarm or further corrective action. A detailed discussion of the results of the inclinometer readings is contained in the report on instrumentation.

Some cracking of the shotcrete was observed just above tunnel level and north of the DOCS. Paint marks were placed at several locations along cracks and measurements are being made at these established locations.

7.3 Tunnel Instrumentation. During construction the tunnel was monitored by the use of extensiometer measurement points installed on 15 steel sets throughout the length of the tunnel. Eyebolts were installed at six locations on each set, and the extensiometer (a spring-loaded steel tape device) was used to determine the distance between measuring points. Two rings of extensiometer measuring points were installed in the ECC and six load cells were placed in the ECC. As discussed in Geologic Conditions Encountered, Section 5.3.3.2, the extensiometer readings indicated two locations where concrete invert slabs were needed and subsequently placed to stabilize the bottoms of the steel sets. The load cell measurements in the ECC indicated the rock anchors were taking loads, but the loads were within an acceptable range. Refer to the report on instrumentation for a detailed list of the tunnel instrumentation readings.

7.4 Reservoir Rim Instrumentation (Survey Points). Six survey monuments were installed in an old landslide mass at the left side of the reservoir rim. Only the initial survey was performed. However, no additional movement has been observed. The monuments will be monitored as part of the Periodic Inspection schedule.

8. RECOMMENDATIONS AND CONSIDERATIONS

8.1 General

a. Do not award a contract solely on the basis of low bid. Enforce the requirement that the prospective Contractor and key personnel assigned to the project to have sufficient prior experience.

b. Staff the field/resident office adequately. Excessive overtime leads to declining safety, quality of work, health and morale.

c. Involve the Local Sponsor in the actual day-to-day construction activities.

d. Prepare for project completion and turnover well in advance.

e. If the contract includes critical milestones or requirements, be explicit as to the consequences, burden or penalty to be assessed for nonperformance. Consider graduated reduction in payment for appropriate work items when noncompliance with the specifications equates to a shorter life cycle, but not necessarily loss of function or a failure.

8.2 Drawings and Specifications, General

a. Be careful about labeling and dimensioning the drawings. Dimensioning can lead to the conclusion that the design lines and grades are more accurate than intended. Where design is to be field fit, clearly indicate on the drawings and in the specifications.

b. Wherever possible, provide the Contractor with good illustrations (Contractors typically look first at the drawings for bidding and building, not the specifications).

c. Make sure definitions and terminology shown on the drawings are exactly as appears in the specifications.

d. Avoid changing specifications and drawings at the last minute.

e. Explicitly state in the specifications the minimum acceptable Contractor Quality Control staff. The staffing requirements should include the organizational structure, the experience of the personnel and size of the staff. Require the major features of work to be the responsibility of an employee of the prime contractor. Prohibit subcontractors or other production people from being responsible for CQC. Include a survey crew as part of the CQC staff.

f. Include bid items and unit prices for equipment rental, including operator, for miscellaneous site work, explorations, and other unforeseen work performed at the direction of the Corps.

8.3 Foundation

a. Prohibit the Contractor from preparing the embankment foundation in a piecemeal fashion. Require that final excavation, dewatering, proof-rolling, etc. be performed in areas large enough to properly use the procedures developed and specified for embankment placement.

b. Require the Contractor to maintain survey stakes with station, offset, elevation, cut or fill over the entire dam footprint on a convenient grid.

c. As with the grouting, make core trench cleanup and foundation preparation "as directed" by the Corps of Engineers. Configure the bid schedule to permit the "as directed" work by the hour. Include an extensive list of the equipment needed to perform the cleanup and preparation.

d. Expand the discussion on dewatering. Cite means and methods appropriate for the site. Emphasize the condition of the foundation required for acceptance and embankment placement.

e. Outline the Foundation Approval process to include surveys, geologic mapping, photographs, documentation, remedial action (as needed), and the official and formal approval requirements to place embankment.

9. REFERENCES

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TABLE 6

Detailed Summary of Foundation Grouting

Note:

Estimated coefficient of permeability (Ke) is calculated by the grouting software package provided by WES. When no gauge pressure is obtained, it is assumed that the hole is full of water and the head pressure is therefore equal to the feet of water above the midpoint of the test interval. The level to which the hole was actually filled by the water available for testing was not known. In these cases, the values calculated could be much smaller than actual. If the test water available did not raise the water level above the bottom of the hole, the Ke estimate would be higher than calculated.

Table 6.
Detailed Summary of Foundation Grouting

								DRILLING DATA		WATER PRESSURE TEST DATA							GROUTING DATA			
HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DEPTH (FT)	DATE COMPLETED	DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
D1030	P 10+30	7.5 U/S	5823.30	4	144.00	41.00	1- 1	0.0- 4.5	06/19/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	06/28/91	4.5- 29.0	07/01/91	5	5.0	7	1.00	2.756	4.5- 29.0	07/01/91	4.20	0.17
							2- 1	29.0- 76.0	07/02/91	29.0- 83.0	07/03/91	25.0	36.70	15	3.67	1.369	29.0- 83.0	07/08/91	51.60	0.96
							- 2	76.0- 83.0	07/03/91	-	/ /						-	/ /		
							3- 1	83.0-112.0	07/12/91	-	/ /						83.0-195.0	07/17/91	9.70	0.09
							- 1	-	/ /	-	/ /						83.0-112.0	07/17/91	59.20	2.04
							- 2	112.0-130.0	07/22/91	112.0-200.0	07/25/91	53	18	22	1.80	0.182	112.0-200.0	07/29/91	30.00	0.34
							- 3	130.0-200.0	07/23/91	-	/ /						-	/ /		
D1033	S 10+33	7.5 U/S	5820.50	4	144.00	43.00	1- 1	0.0- 4.5	07/15/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	07/23/91	5.0- 29.0	07/25/91	5	7.3	7	1.46	3.958	5.0- 29.0	07/29/91	0.50	0.02
							2- 1	29.0- 89.0	07/31/91	29.0- 87.0	07/31/91	25	31.3	17	3.13	1.057	29.0- 89.0	08/02/91	64.10	1.07
D1035	P 10+35	7.5 U/S	5818.80	4	144.00	45.00	1- 1	0.0- 4.5	06/19/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	06/28/91	4.5- 29.0	07/01/91	5	0.1	7	0.02	0.053	4.5- 29.0	07/01/91	0.20	0.01
							2- 1	29.0- 83.0	07/02/91	29.0- 83.0	07/03/91	25.0	35.6	15	3.56	1.275	29.0- 83.0	07/08/91	43.00	0.80
							3- 1	83.0-174.0	07/11/91	-	/ /						83.0-174.0	07/17/91	95.80	1.05
							- 2	174.0-200.0	07/22/91	174.0-200.0	07/25/91	53	30.1	22	3.01	0.734	174.0-200.0	07/29/91	78.70	3.03
D1038	S 10+38	7.5 U/S	5816.20	4	144.00	46.50	1- 1	0.0- 4.5	07/15/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	07/23/91	5.0- 29.0	07/25/91	5	9.6	7	1.92	5.006	5.0- 29.0	07/29/91	2.50	0.10
							2- 1	29.0- 89.0	07/31/91	29.0- 89.0	07/31/91	25	13.5	17	1.35	0.424	29.0- 89.0	08/01/91	5.30	0.09
D1040	P 10+40	7.5 U/S	5814.80	4	144.00	48.00	1- 1	0.0- 4.5	06/19/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	06/28/91	4.5- 29.0	07/01/91	5	1.0	7	0.20	0.510	4.5- 29.0	07/01/91	0.60	0.02
							2- 1	29.0- 83.0	07/02/91	29.0- 83.0	07/03/91	25.0	24.5	15	2.45	0.853	29.0- 83.0	07/03/91	16.50	0.31
							3- 1	83.0-185.0	07/10/91	-	/ /						83.0-200.0	07/16/91	143.00	1.22
							- 1	185.0-200.0	07/11/91	-	/ /						-	/ /		
D1043	S 10+43	7.5 U/S	5812.00	4	144.00	50.00	1- 1	0.0- 4.5	07/15/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	07/23/91	5.0- 29.0	07/25/91	5	7.1	7	1.42	3.574	5.0- 29.0	07/26/91	25.60	1.07
							2- 1	29.0- 89.0	07/30/91	29.0- 89.0	07/31/91	25	14.5	17	1.45	0.441	29.0- 89.0	08/01/91	4.00	0.07
D1045	P 10+45	7.5 U/S	5810.20	4	144.00	52.00	1- 1	0.0- 4.5	06/19/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	06/28/91	4.5- 29.0	07/01/91	5	0.9	7	0.18	0.442	4.5- 29.0	07/01/91	0.30	0.01
							2- 1	29.0- 83.0	07/02/91	29.0- 83.0	07/03/91	25.0	28.9	15	2.89	0.974	29.0- 83.0	07/03/91	50.90	0.94
							3- 1	83.0-145.0	07/09/91	-	/ /						83.0-130.0	07/16/91	91.50	1.95
							- 3	145.0-200.0	07/30/91	145.0-200.0	07/31/91	53	27.8	22	2.78	0.351	145.0-200.0	08/01/91	186.50	3.39

								DRILLING DATA		WATER PRESSURE TEST DATA							GROUTING DATA			
HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DEPTH (FT)	DATE COMPLETED	DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
D1048	S 10+48	7.5	5808.00	4	144.00	54.50	1- 1	0.0- 4.5	04/06/93	-	/ /						-	/ /		
							- 2	4.5- 29.0	07/23/91	5.0- 29.0	07/25/91	5	0.1	7	0.02	0.048	5.0- 29.0	07/26/91	0.30	0.01
							2- 1	29.0- 89.0	07/30/91	29.0- 89.0	07/31/91	25	5.6	17	0.56	0.164	29.0- 89.0	07/31/91	2.90	0.05
C1050	Q 10+50	4.3 U/S	5806.80	3	144.00	64.00	1- 1	0.0- 5.5	11/09/90	-	/ /						-	/ /		
							- 2	4.5- 55.0	12/03/90	4.5- 55.0	12/03/90	25	0.5	12	0.10	0.046	4.5- 83.0	12/08/90	29.30	0.37
							- 2	55.0- 75.0	12/04/90	55.0- 70.0	12/04/90	25	9.9	20	1.98	1.637	-	/ /		
							3- 1	75.0-155.0	12/11/90	70.0-155.0	12/12/90	53	13.0	20	1.30	0.134	70.0-155.0	12/12/90	11.60	0.14
							- 2	155.0-170.0	12/13/90	155.0-170.0	12/13/90	53.0	43.7	20	4.37	1.485	155.0-170.0	12/17/90	57.30	3.82
D1050	P 10+50	7.5 U/S	5806.70	4	144.00	57.00	1- 1	0.0- 4.5	06/19/91	-	/ /						-	/ /		
							- 2	4.5- 29.0	06/28/91	4.5- 29.0	07/01/91	5	2.1	7	0.42	0.989	4.5- 29.0	07/01/91	9.90	0.40
							2- 1	29.0- 83.0	07/02/91	29.0- 83.0	07/03/91	25.0	18.2	15	1.82	0.591	29.0- 83.0	07/03/91	45.50	0.84
							3- 1	83.0-142.0	07/09/91	-	/ /						-	/ /		
							- 2	5.0-142.0	07/19/91	-	/ /						83.0-142.0	07/25/91	17.40	0.29
							- 3	142.0-200.0	07/23/91	142.0-200.0	07/25/91	53	25.2	22	2.52	0.294	142.0-200.0	07/25/91	52.20	0.90
C1051	Q 10+51	4.5 U/S	5807.00	3	144.00	64.00	1- 1	0.0- 4.5	12/17/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	06/11/91	-	/ /						-	/ /		
							2- 1	27.0- 83.0	06/11/91	4.5- 83.0	06/11/91	25	3.7	10	0.74	0.194	4.5- 83.0	06/11/91	30.20	0.38
							3- 1	83.0-100.0	06/14/91	83.0-100.0	06/14/91	53.0	12.9	12	2.58	1.128	83.0-100.0	06/18/91	76.10	4.48
							- 2	100.0-150.0	06/24/91	100.0-150.0	06/24/91	61.0	7.8	15	0.78	0.118	100.0-150.0	06/26/91	51.80	1.04
							- 2	-	/ /	100.0-150.0	06/25/91	53.0	8.8		1.76	0.266	-	/ /		
							- 3	150.0-155.0	06/27/91	150.0-155.0	06/27/91	53.0	42.6	20	4.26	3.491	150.0-155.0	06/28/91	48.20	9.64
							- 4	155.0-170.0	07/01/91	155.0-170.0	07/01/91	53.0	11.5	17	1.15	0.391	155.0-170.0	07/01/91	3.40	0.23
C1052	T 10+52	4.6 U/S	5805.10	3	144.00	64.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	10/12/90	4.5- 27.0	10/12/90	5	0.2	7	0.04	0.306	-	/ /		
							2- 1	27.0- 83.0	10/22/90	27.0- 83.0	10/22/90	25	17.4	15	3.48	1.061	27.0- 83.0	10/23/90	31.40	0.56
							3- 1	83.0-105.0	11/16/90	83.0-105.0	11/17/90	53.0	9.0	15	1.80	0.629	83.0-105.0	11/17/90	39.70	1.80
							- 2	105.0-135.0	11/18/90	105.0-135.0	11/19/90	53.0	27.0	15	5.40	2.083	105.0-135.0	11/20/90	166.00	5.53
							- 3	135.0-145.0	11/21/90	135.0-145.0	11/21/90	30.0	26.0	15	5.20	4.125	135.0-140.0	11/26/90	103.60	20.72
							- 4	145.0-170.0	11/28/90	145.0-170.0	11/28/90	53.0	27.7	15	5.54	1.890	145.0-170.0	11/29/90	103.50	4.14
C1055	Q 10+55	4.8 U/S	5802.80	3	144.00	65.00	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 83.0	12/03/90	4.5- 83.0	12/03/90	25	13.9	12	2.78	1.618	-	/ /		
							3- 1	83.0-115.0	12/07/90	83.0-115.0	12/07/90	53.0	24.3	15	4.86	1.214	83.0-115.0	12/10/90	66.80	2.09
							- 2	115.0-170.0	12/11/90	115.0-170.0	12/12/90	53	15.3	20	1.53	0.196	115.0-170.0	12/12/90	36.70	0.67
A1055	S 10+55.0	7.3 U	5802.90	1	144.00	65.00	1- 1	0.0- 5.5	06/28/90	-	/ /						0.0- 5.5	09/20/90	12.50	2.27

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1055	S 10+55.0	7.3 U	5802.90	1	144.00	65.00	1- 2	5.5- 27.0	09/08/90	5.5- 27.0	09/11/90	5	14.0	15	2.80	7.095	5.5- 27.0	09/11/90	47.50	2.21
							2- 1	27.0- 70.0	09/19/90	27.0- 70.0	09/20/90	25	24.7	15	4.94	3.498	27.0- 70.0	09/20/90	79.00	1.84
							- 2	70.0- 83.0	09/21/90	70.0- 83.0	09/24/90	25	3.0	7	0.60	0.483	70.0- 83.0	09/24/90	1.20	0.09
C1057	P 10+57.5	4.9 U	5800.79	3	144.00	65.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	10/10/90	4.5- 27.0	10/11/90	5	2.2	7	0.44	1.095	4.5- 27.0	10/11/90	2.00	0.09
							2- 1	27.0- 50.0	10/12/90	27.0- 83.0	10/13/90	25	23.7	15	4.74	2.355	27.0- 74.0	10/15/90	95.70	2.04
							- 1	50.0- 70.0	10/13/90	70.0- 83.0	10/16/90	25	0.9	7	0.18	0.151	-	/ /		
							- 2	70.0- 83.0	10/16/90	-	/ /						70.0- 79.0	10/16/90	2.70	0.30
							3- 1	83.0-110.0	10/26/90	83.0-110.0	10/26/90	53.0	5.7	12	1.14	0.331	83.0-110.0	10/27/90	14.60	0.54
							- 1	-	/ /	15.0- 95.0	10/30/90	53	18.3	15	3.66	0.568	83.0- 95.0	10/30/90	33.80	2.82
							- 1	-	/ /	50.0-110.0	10/31/90	53.0	22.8	15	4.56	1.472	83.0-110.0	11/01/90	117.90	4.37
							- 2	110.0-120.0	11/02/90	110.0-120.0	11/02/90	23.0	31.6	15	6.32	6.051	110.0-120.0	11/09/90	107.20	10.72
							- 3	120.0-150.0	11/10/90	120.0-150.0	11/10/90	53.0	30.5	15	6.10	2.075	120.0-150.0	11/10/90	154.10	5.14
							- 4	150.0-170.0	11/11/90	150.0-160.0	11/11/90	53.0	7.2	15	1.44	0.688	150.0-170.0	11/11/90	139.50	6.98
							- 4	-	/ /	150.0-170.0	11/11/90	53.0	13.3	15	2.66	0.720	-	/ /		
							- 5	170.0-200.0	11/12/90	170.0-200.0	11/12/90	53.0	0.8	15	0.16	0.029	170.0-200.0	11/12/90	1.70	0.06
C1059	Q 10+59	5.0 U/S	5799.50	3	144.00	66.00	1- 1	0.0- 4.5	12/17/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	06/10/91	-	/ /						-	/ /		
							2- 1	27.0- 45.0	06/10/91	4.5- 83.0	06/11/91	25	1.5	10	0.38	0.099	4.5- 83.0	06/11/91	1.20	0.02
							- 1	45.0- 83.0	06/11/91	-	/ /						-	/ /		
							3- 1	83.0-140.0	06/13/91	83.0-140.0	06/14/91	53.0	19.4	12	3.88	0.938	83.0-140.0	06/18/91	196.60	3.45
							- 2	140.0-145.0	06/24/91	140.0-145.0	06/24/91	0.2	29.1	15	2.91	3.772	140.0-145.0	06/25/91	314.50	62.90
							- 2	-	/ /	140.0-145.0	06/25/91	23.0	16.7	15	3.34	4.330	-	/ /		
							- 3	145.0-200.0	06/27/91	145.0-200.0	06/27/91	53.0	22.9	17	2.29	0.262	145.0-200.0	06/27/91	50.80	0.92
C1060	Q 10+60	5.1 U/S	5798.90	3	144.00	66.00	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 83.0	12/01/90	4.5- 83.0	12/03/90	25	1.7	12	0.34	0.088	4.5- 83.0	12/04/90	7.80	0.10
							3- 1	83.0-150.0	12/07/90	83.0-150.0	12/07/90	53.0	20.4	15	4.08	0.499	83.0-150.0	12/10/90	30.60	0.46
							- 2	150.0-180.0	12/11/90	150.0-180.0	12/12/90	53.0	36.9	20	3.69	0.703	150.0-180.0	12/12/90	125.50	4.18
							- 3	180.0-200.0	12/13/90	180.0-200.0	12/13/90	53	2.8	20	0.28	0.071	180.0-200.0	12/17/90	2.70	0.14
A1060	T 10+60.0	7.5 U	5798.90	1	144.00	66.00	1- 1	0.0- 5.5	06/28/90	-	/ /						0.0- 5.5	09/28/90	30.60	5.56
							- 2	5.5- 27.0	09/12/90	5.5- 27.0	09/13/90	2	21.6	15	4.32	15.965	5.5- 27.0	09/13/90	29.10	1.35
							2- 1	27.0- 83.0	09/25/90	27.0- 83.0	09/26/90	25	7.2	7	1.44	0.436	27.0- 83.0	09/28/90	44.80	0.80
C1061	Q 10+61	5.2 U/S	5797.90	3	144.00	66.00	1- 1	0.0- 4.5	12/17/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	06/10/91	-	/ /						-	/ /		
							2- 1	27.0- 83.0	06/10/91	4.5- 83.0	06/11/91	25	1.2	10	0.24	0.062	4.5- 83.0	06/11/91	0.70	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1061	Q 10+61	5.2 U/S	5797.90	3	144.00	66.00	3- 1	83.0-175.0	06/13/91	83.0-175.0	06/14/91	53.0	21.7	12	4.34	0.381	83.0-175.0	06/17/91	68.70	0.75
							- 2	175.0-200.0	06/21/91	175.0-200.0	06/24/91	61.0	6.4	12	1.28	0.271	175.0-200.0	06/25/91	10.00	0.40
C1062	T 10+62	5.3 U/S	5797.00	3	144.00	66.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	10/12/90	4.5- 27.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	27.0- 83.0	10/18/90	27.0- 83.0	10/22/90	25	1.3	7	0.26	0.078	27.0- 83.0	10/22/90	2.50	0.04
							3- 1	83.0-135.0	11/16/90	83.0-100.0	11/17/90	53.0	19.8	15	3.96	1.712	83.0-100.0	11/17/90	95.90	5.64
							- 2	135.0-150.0	11/18/90	135.0-150.0	11/19/90	53.0	27.1	15	5.42	3.028	135.0-150.0	11/20/90	171.50	11.43
							- 4	150.0-165.0	11/28/90	150.0-165.0	11/28/90	53.0	28.2	15	5.64	2.851	150.0-165.0	11/29/90	173.70	11.58
							- 5	165.0-200.0	11/30/90	165.0-200.0	11/30/90	53.0	1.5	15	0.30	0.048	165.0-200.0	11/30/90	4.40	0.13
B1062	P 10+62.5	2.7 U	5797.00	2	144.00	66.50	1- 1	0.0- 4.5	09/25/90	-	/ /						0.0- 83.0	10/06/90	10.20	0.12
							- 2	4.5- 27.0	10/01/90	4.5- 27.0	10/01/90	5	6.3	7	1.26	3.119	4.5- 27.0	10/01/90	1.20	0.05
							2- 1	27.0- 60.0	10/03/90	27.0- 60.0	10/03/90	25	7.9	14	1.58	0.847	27.0- 83.0	10/04/90	40.80	0.73
							- 1	-	/ /	-	/ /						0.0- 83.0	10/06/90		
							- 2	60.0- 83.0	10/05/90	60.0- 83.0	10/05/90	60	1.5	7	0.30	0.159	60.0- 83.0	10/05/90	4.10	0.18
C1065	Q 10+65	5.4 U/S	5794.30	3	144.00	67.00	1- 1	0.0- 4.5	11/09/90	-	/ /						-	/ /		
							- 2	4.5- 83.0	12/01/90	4.5- 83.0	12/03/90	25	1.4	12	0.28	0.073	4.5- 83.0	12/04/90	1.20	0.02
							2- 1	83.0-200.0	12/05/90	-	/ /						83.0-200.0	12/10/90	61.40	0.52
A1065	P 10+65.0	7.8 U	5794.30	1	144.00	67.00	1- 1	0.0- 5.5	06/27/90	-	/ /						-	/ /		
							- 2	5.5- 27.0	07/03/90	5.5- 27.0	07/04/90	5	01	7	0.20	0.501	8.0- 27.0	07/04/90	0.90	0.05
							- 2	-	/ /	-	/ /						5.5- 27.0	07/04/90	0.20	0.01
							2- 1	27.0- 77.0	09/14/90	27.0- 77.0	09/14/90	25.0	22.2	20	4.44	2.547	27.0- 77.0	09/18/90	57.40	1.15
C1067	S 10+67.5	5.4 U	5793.30	3	144.00	67.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	10/12/90	4.5- 27.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	27.0- 83.0	10/16/90	27.0- 83.0	10/17/90	25	0.5	7	0.10	0.030	27.0- 83.0	10/17/90	0.70	0.01
							3- 1	83.0-160.0	11/13/90	83.0-160.0	11/13/90	53.0	28.6	15	5.72	0.972	83.0-160.0	11/13/90	113.10	1.47
							- 2	160.0-170.0	11/14/90	160.0-170.0	11/14/90	53.0	21.1	15	4.22	1.912	160.0-170.0	11/14/90	87.40	8.74
							- 3	170.0-200.0	11/15/90	170.0-200.0	11/15/90	53.0	7.8	15	1.56	0.283	170.0-200.0	11/15/90	50.50	1.68
C1070	Q 10+70	5.6 U/S	5791.20	3	144.00	68.00	1- 1	0.0- 4.5	11/19/90	-	/ /						-	/ /		
							- 2	4.5- 83.0	12/01/90	4.5- 83.0	12/03/90	25	0.4	12	0.08	0.021	4.5- 83.0	12/04/90	1.10	0.01
							2- 1	83.0-195.0	12/05/90	-	/ /						83.0-195.0	12/08/90	18.70	0.17
A1070	T 10+70.0	8.1 U	5791.20	1	144.00	68.00	1- 1	0.0- 5.5	06/28/90	-	/ /						-	/ /		
							- 2	5.5- 27.0	09/10/90	5.5- 27.0	09/11/90	5	13.5	12	2.70	6.736	5.5- 27.0	09/13/90	46.70	2.17
							2- 1	27.0- 83.0	09/25/90	27.0- 83.0	09/26/90	25	5.0	7	1.00	0.300	27.0- 83.0	09/27/90	20.30	0.36

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1072	T 10+72	5.8 U/S	5790.20	3	144.00	68.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	10/12/90	4.5- 27.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	27.0- 83.0	10/18/90	27.0- 83.0	10/22/90	25	1.9	15	0.38	0.114	27.0- 83.0	10/22/90	2.70	0.05
							- 1	-	/ /	-	/ /						26.0- 78.0	10/23/90	9.30	0.18
							3- 1	83.0-100.0	11/16/90	83.0-135.0	11/17/90	53.0	35.5	15	7.10	1.856	83.0-135.0	11/17/90	125.10	2.41
							- 2	100.0-195.0	11/19/90	100.0-295.0	11/19/90	53.0	8.3	15	1.66	0.062	100.0-195.0	11/20/90	39.90	0.42
B1072	S 10+72.5	3.2 U	5790.20	2	144.00	68.50	1- 1	0.0- 4.5	09/25/90	-	/ /						0.0- 83.0	10/09/90	20.40	0.25
							- 2	4.5- 27.0	10/02/90	4.5- 27.0	10/02/90	5	0.01	7	0.00		4.5- 27.0	10/02/90	0.30	0.01
							2- 1	27.0- 83.0	10/08/90	27.0- 83.0	10/08/90	25	1.5	7	0.30	0.090	27.0- 83.0	10/09/90	1.10	0.02
C1074	Q 10+74	5.9 U/S	5789.00	3	144.00	68.00	1- 1	0.0- 4.5	12/17/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	06/07/91	-	/ /						-	/ /		
							2- 1	27.0- 75.0	06/07/91	4.5- 83.0	06/11/91	25	0.4	10	0.08	0.021	4.5- 83.0	06/11/91	0.50	0.01
							- 1	75.0- 83.0	06/10/91	-	/ /						-	/ /		
							3- 1	83.0-195.0	06/12/91	83.0-195.0	06/14/91	53.0	8.3	12	1.66	0.118	83.0-195.0	06/14/91	21.30	0.19
C1075	Q 10+75	6.0 U/S	5788.30	3	144.00	69.00	1- 1	0.0- 4.5	11/19/90	-	/ /						-	/ /		
							- 2	4.5- 83.0	12/01/90	4.5- 83.0	12/03/90	25	0.4	12	0.08	0.047	-	/ /		
							- 2	70.0- 83.0	12/05/90	-	/ /						-	/ /		
							2- 1	83.0-195.0	12/05/90	-	/ /						4.5- 83.0	12/04/90	0.80	0.01
A1075	S 10+75.0	8.3 U	5788.30	1	144.00	69.00	1- 1	0.0- 5.5	06/28/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	07/05/90	5.5- 29.0	07/06/90	5	6.5	7	1.30	2.883	8.0- 29.0	07/07/90	17.50	0.83
							- 2	-	/ /	-	/ /						5.5- 29.0	07/07/90	0.80	0.03
							2- 1	27.0- 83.0	09/19/90	27.0- 83.0	09/20/90	25	0.3	7	0.06	0.018	27.0- 83.0	09/20/90	1.30	0.02
C1076	Q 10+76	6.0 U/S	5787.70	3	144.00	68.00	1- 1	0.0- 4.5	12/17/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	06/07/91	-	/ /						-	/ /		
							2- 1	27.0- 83.0	06/07/91	4.5- 83.0	06/11/91	25.0	0.4	10	0.08	0.021	4.5- 83.0	06/11/91	0.30	0.00
							3- 1	83.0-195.0	06/12/91	83.0-195.0	06/14/91	53.0	7.1	12	1.42	0.101	83.0-195.0	06/14/91	7.70	0.07
C1077	P 10+77.5	6.0 U	5787.00	3	144.00	69.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 27.0	10/11/90	4.5- 27.0	10/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	27.0- 83.0	10/13/90	27.0- 83.0	10/13/90	25	0.1	7	0.02	0.006	27.0- 83.0	10/15/90	0.50	0.01
							3- 1	83.0-160.0	10/26/90	83.0-160.0	10/26/90	53.0	22.4	12	4.48	0.468	83.0-160.0	10/27/90	52.30	0.68
							- 2	160.0-190.0	10/29/90	160.0-190.0	10/30/90	53	5.0	15	1.00	0.182	160.0-190.0	10/30/90	72.20	2.41
A1080	T 10+80.0	8.6 U	5784.20	1	144.00	70.00	1- 1	0.0- 5.5	06/28/90	-	/ /						-	/ /		
							- 2	5.5- 27.0	09/10/90	5.5- 27.0	09/11/90	5	0.1	7	0.02	0.049	5.5- 27.0	09/13/90	0.70	0.03

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1080	T 10+80.0	8.6 U	5784.20	1	144.00	70.00	2- 1	27.0- 70.0	09/25/90	27.0- 70.0	09/26/90	25	26.3	12	5.26	3.592	27.0- 70.0	09/27/90	52.40	1.22
							- 2	70.0- 83.0	09/28/90	70.0- 83.0	09/28/90	25	0.2	7	0.04	0.031	70.0- 83.0	09/28/90	0.30	0.02
C1082	T 10+82	6.1 U/S	5782.00	3	144.00	71.00	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/12/90	4.5- 26.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	10/18/90	26.0- 78.0	10/22/90	25	0.6	15	0.12	0.039	26.0- 78.0	10/23/90	11.20	0.22
							3- 1	78.0-195.0	11/16/90	78.0-195.0	11/17/90	53.0	0.2	15	0.04	0.003	78.0-195.0	11/17/90	0.60	0.01
B1082	P 10+82.5	3.7 U	5782.00	2	144.00	71.00	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/01/90	4.5- 26.0	10/01/90	5	0.8	7	0.11	0.283	4.5- 26.0	10/01/90	0.50	0.02
							2- 1	26.0- 78.0	10/03/90	26.0- 78.0	10/03/90	25	1.0	7	0.20	0.065	26.0- 78.0	10/04/90	0.80	0.02
A1085	P 10+85.0	8.9 U	5781.80	1	144.00	72.00	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	07/03/90	5.5- 26.0	07/04/90	5	01	7	0.20	0.521	8.0- 26.0	07/04/90	0.40	0.02
							- 2	-	/ /	-	/ /						5.5- 26.0	07/04/90	2.00	0.10
							2- 1	26.0- 76.0	09/14/90	26.0- 76.0	09/14/90	25	1.2	7	0.24	0.082	26.0- 76.0	09/17/90	11.60	0.23
C1087	S 10+87.5	6.5 U	5779.00	3	144.00	72.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/12/90	4.5- 26.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	10/16/90	26.0- 78.0	10/17/90	25	1.1	7	0.22	0.071	26.0- 78.0	10/17/90	1.00	0.02
							3- 1	78.0-100.0	10/31/90	78.0-100.0	10/31/90	53	20.6	15	4.12	2.607	78.0-100.0	11/01/90	59.50	2.70
							- 2	100.0-110.0	11/02/90	100.0-110.0	11/02/90	23.0	30.1	15	6.02	6.023	100.0-110.0	11/02/90	188.70	18.87
							- 3	110.0-160.0	11/05/90	110.0-195.0	11/08/90	53.0	7.7	15	1.54	0.127	110.0-195.0	11/08/90	10.40	0.12
							- 4	160.0-170.0	11/07/90	-	/ /						-	/ /		
							- 5	170.0-195.0	11/08/90	-	/ /						-	/ /		
C1090	Q 10+90	6.9 U/S	5778.00	3	144.00	73.00	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	11/12/90	4.5- 26.0	11/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	11/12/90	26.0- 78.0	11/12/90	25	1.5	12	0.30	0.097	26.0- 78.0	11/13/90	1.40	0.03
A1090	T 10+90.0	9.1 U	5778.30	1	144.00	73.00	1- 1	0.0- 5.5	06/28/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	09/10/90	5.5- 26.0	09/11/90	5	6.4	7	1.28	3.319	5.5- 26.0	09/13/90	2.40	0.12
							2- 1	26.0- 78.0	09/25/90	26.0- 78.0	09/26/90	25	0.01	7	0.00		26.0- 78.0	09/27/90	0.80	0.02
C1092	T 10+92	6.9 U/S	5777.00	3	144.00	73.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/12/90	4.5- 26.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	10/18/90	26.0- 78.0	10/22/90	25	11.2	7	2.24	0.725	26.0- 78.0	10/22/90	28.80	0.55
							3- 1	78.0-190.0	11/09/90	78.0-190.0	11/09/90	53.0	24.8	15	4.96	0.351	78.0-190.0	11/10/90	64.50	0.58
B1092	S 10+92.5	4.3 U	5777.00	2	144.00	74.00	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1092	S 10+92.5	4.3 U	5777.00	2	144.00	74.00	1- 2	4.5- 26.0	10/02/90	4.5- 26.0	10/02/90	5	1.5	7	0.30	0.763	4.5- 26.0	10/02/90	1.20	0.06
							2- 1	26.0- 78.0	10/08/90	26.0- 78.0	10/08/90	25	5.1	7	1.02	0.329	26.0- 78.0	10/09/90	1.30	0.03
C1093	Q 10+93	7.0 U/S	5776.50	3	144.00	73.50	1- 1	0.0- 4.5	11/14/90	-	/ /						-	/ /		
							- 2	4.5- 78.0	11/14/90	4.5- 78.0	11/14/90	25	0.9	12	0.18	0.050	4.5- 78.0	11/14/90	4.20	0.06
C1095	Q 10+95	7.0 U/S	5775.20	3	144.00	74.50	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	11/12/90	4.5- 26.0	11/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	11/12/90	26.0- 78.0	11/12/90	25	3.2	12	0.64	0.206	26.0- 78.0	11/12/90	9.30	0.18
A1095	S 10+95.0	9.4 U	5776.00	1	144.00	74.50	1- 1	0.0- 5.5	06/28/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	07/05/90	5.5- 29.0	07/06/90	5	2.4	7	0.48	1.041	8.0- 29.0	07/07/90	1.10	0.05
							- 2	-	/ /	-	/ /						5.5- 29.0	07/07/90	0.30	0.01
							2- 1	26.0- 78.0	09/19/90	26.0- 78.0	09/20/90	25	8.0	7	1.60	0.516	26.0- 78.0	09/20/90	28.60	0.55
C1096	Q 10+96	7.0 U/S	5775.00	3	144.00	74.50	1- 1	0.0- 5.5	11/14/90	-	/ /						-	/ /		
							- 2	5.5- 78.0	11/14/90	5.5- 78.0	11/14/90	25.0	1.2	12	0.24	0.067	5.5- 78.0	11/14/90	1.70	0.02
C1097	P 10+97.5	7.0 U	5774.50	3	144.00	75.00	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/11/90	4.5- 26.0	10/11/90	5	0.5	7	0.10	0.792	-	/ /		
							2- 1	26.0- 78.0	10/13/90	26.0- 78.0	10/13/90	25	4.9	7	0.98	0.316	26.0- 78.0	10/15/90	10.00	0.19
							3- 1	78.0-160.0	10/25/90	78.0-160.0	10/26/90	53.0	21.7	12	4.34	0.683	78.0-160.0	10/27/90	146.50	1.79
							- 2	160.0-190.0	10/29/90	160.0-190.0	10/30/90	53	6.7	15	1.34	0.239	160.0-190.0	10/30/90	55.70	1.86
A1100	T 11+00.0	9.7 U	5773.10	1	144.00	75.90	1- 1	0.0- 5.5	06/28/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	09/10/90	5.5- 26.0	09/11/90	5.0	1.5	12	0.30	0.770	5.5- 26.0	09/12/90	1.30	0.06
							2- 1	26.0- 78.0	09/25/90	26.0- 78.0	09/26/90	25	1.1	7	0.22	0.071	26.0- 78.0	09/27/90	0.90	0.02
C1102	T 11+02	7.5 U/S	5771.60	3	144.00	77.00	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/24/90	4.5- 26.0	10/24/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	10/24/90	26.0- 98.0	10/24/90	25	1.5	7	0.30	0.065	26.0- 78.0	10/24/90	0.60	0.01
B1102	P 11+02.5	4.8 U	5771.60	2	144.00	77.00	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/01/90	4.5- 26.0	10/01/90	5	1.3	7	0.26	0.655	4.5- 26.0	10/01/90	0.80	0.04
							2- 1	26.0- 78.0	10/03/90	26.0- 78.0	10/03/90	25	0.2	7	0.04	0.013	26.0- 78.0	10/04/90	0.40	0.01
A1105	P 11+05.0	9.9 U	5770.00	1	144.00	77.50	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	07/03/90	5.5- 26.0	07/04/90	5	1	7	0.20	0.511	8.0- 26.0	07/04/90	0.40	0.02
							- 2	-	/ /	-	/ /						5.5- 26.0	07/04/90	0.20	0.01
							2- 1	26.0- 76.0	09/14/90	26.0- 76.0	09/14/90	25	4.3	7	0.86	0.288	26.0- 76.0	09/17/90	1.00	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1107	S 11+07.5	7.6	U 5768.60	3	144.00	78.50	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/12/90	4.5- 26.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	26.0- 78.0	10/16/90	26.0- 78.0	10/17/90	25	1.7	7	0.34	0.109	26.0- 78.0	10/17/90	0.60	0.01
							3- 1	78.0-153.0	10/31/90	78.0-153.0	10/31/90	53	6.3	15	1.26	0.140	78.0-153.0	11/01/90	7.30	0.10
A1110	T 11+10.0	10.2	U 5767.00	1	144.00	79.30	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	09/10/90	5.5- 26.0	09/11/90	5	11.0	7	2.20	5.599	5.5- 26.0	09/12/90	17.20	0.84
							2- 1	26.0- 78.0	04/30/93	-	/ /						26.0- 78.0	09/27/90	1.80	0.03
B1112	S 11+12.5	5.3	U 5765.40	2	144.00	80.00	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/02/90	4.5- 26.0	10/02/90	5	0.01	7	0.00		4.5- 26.0	10/02/90	0.20	0.01
							2- 1	26.0- 78.0	10/06/90	26.0- 78.0	10/08/90	25	1.4	7	0.28	0.089	26.0- 78.0	10/09/90	1.50	0.03
A1115	S 11+15.0	10.5	U 5763.80	1	144.00	81.10	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/05/90	5.5- 29.0	07/06/90	5	1.15	7	0.23	0.490	8.0- 29.0	07/07/90	0.70	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	07/07/90	0.30	0.01
							2- 1	26.0- 78.0	09/19/90	26.0- 78.0	09/20/90	25	0.4	7	0.08	0.025	26.0- 78.0	09/20/90	0.60	0.01
C1117	P 11+17.5	8.1	U 5761.70	3	144.00	82.00	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 26.0	10/11/90	4.5- 26.0	10/11/90	5	0.4	7	0.08	0.634	-	/ /		
							2- 1	26.0- 78.0	10/13/90	26.0- 78.0	10/13/90	25	1.2	7	0.24	0.076	26.0- 78.0	10/15/90	1.60	0.03
							3- 1	78.0-152.0	10/25/90	78.0-152.0	10/26/90	53.0	4.6	12	0.92	0.103	78.0-152.0	10/26/90	8.20	0.11
A1120	T 11+20.0	10.7	U 5762.00	1	144.00	82.90	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	09/10/90	5.5- 26.0	09/11/90	5	4.7	7	0.94	2.376	5.5- 26.0	09/12/90	0.70	0.03
							2- 1	26.0- 78.0	09/21/90	26.0- 78.0	09/24/90	25	0.4	7	0.08	0.025	26.0- 78.0	09/27/90	1.00	0.02
B1122	P 11+22.5	5.9	U 5759.00	2	144.00	84.00	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/01/90	4.5- 25.0	10/01/90	5	7.7	7	1.54	4.066	4.5- 25.0	10/01/90	6.10	0.30
							2- 1	25.0- 75.0	10/03/90	25.0- 75.0	10/03/90	25	2.3	7	0.46	0.154	25.0- 75.0	10/04/90	20.20	0.40
A1125	P 11+25.0	11.0	U 5756.00	1	144.00	84.50	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/03/90	5.5- 25.0	07/04/90	5	02	7	0.40	1.074	5.5- 25.0	07/04/90	1.60	0.08
							2- 1	25.0- 75.0	09/14/90	25.0- 75.0	09/14/90	25	16.2	7	3.24	1.084	26.0- 76.0	09/17/90	48.90	0.98
C1127	S 11+27.5	8.6	U 5754.40	3	144.00	88.00	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/12/90	4.5- 25.0	10/12/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	10/16/90	25.0- 75.0	10/17/90	25	0.4	7	0.08	0.027	25.0- 75.0	10/17/90	0.90	0.02
							3- 1	75.0-150.0	10/31/90	75.0-150.0	10/31/90	53	3.0	15	0.60	0.067	75.0-150.0	11/01/90	2.70	0.04

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1130	T 11+30.0	11.3 U	5752.80	1	144.00	86.10	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	09/10/90	5.5- 25.0	09/11/90	5	0.4	7	0.08	0.214	5.5- 25.0	09/12/90	0.40	0.02
							2- 1	25.0- 75.0	09/21/90	25.0- 75.0	09/24/90	25	4.7	7	0.94	0.314	26.0- 78.0	09/26/90	40.60	0.78
C1132	T 11+32	9 U/S	5751.20	3	144.00	87.50	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/24/90	4.5- 25.0	10/24/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	10/24/90	25.0- 75.0	10/24/90	25	0.7	7	0.14	0.047	25.0- 75.0	10/24/90	0.90	0.02
B1132	S 11+32.5	6.4 U	5751.20	2	144.00	87.50	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/02/90	4.5- 25.0	10/02/90	5	0.6	7	0.12	0.316	4.5- 25.0	10/02/90	0.50	0.02
							2- 1	25.0- 75.0	10/06/90	25.0- 75.0	10/08/90	25	5.6	7	1.12	0.374	25.0- 75.0	10/09/90	4.00	0.08
A1135	S 11+35.0	11.5 U	5749.50	1	144.00	88.90	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/05/90	5.5- 29.0	07/06/90	5	3	7	0.60	1.268	8.0- 29.0	07/06/90	31.80	1.51
							- 2	-	/ /	-	/ /						5.5- 29.0	07/06/90	6.20	0.26
							2- 1	25.0- 75.0	09/19/90	25.0- 75.0	09/20/90	25	4.4	7	0.88	0.294	25.0- 75.0	09/20/90	5.60	0.11
C1137	P 11+37.5	9.2 U	5748.20	3	0.00	90.00	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/11/90	4.5- 25.0	10/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	10/13/90	25.0- 75.0	10/13/90	25	7.2	7	1.44	0.480	25.0- 75.0	10/15/90	20.10	0.40
							3- 1	75.0-150.0	10/25/90	75.0-150.0	10/26/90	53.0	1.3	12	0.26	0.029	75.0-150.0	10/26/90	1.80	0.02
A1140	T 11+40.0	11.8 U	5746.30	1	0.00	90.00	1- 1	0.0- 5.5	06/26/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	09/10/90	5.5- 25.0	09/11/90	5	0.01	7	0.00		5.5- 25.0	09/12/90	0.50	0.03
							2- 1	25.0- 75.0	09/21/90	25.0- 75.0	09/24/90	25	10.0	7	2.00	0.667	25.0- 75.0	09/26/90	45.00	0.90
C1142	T 11+42	10 U/S	5744.90	3	0.00	90.00	1- 1	0.0- 4.5	10/23/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/24/90	4.5- 25.0	10/24/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	10/24/90	25.0- 75.0	10/24/90	25	0.4	7	0.08	0.027	25.0- 75.0	10/24/90	0.50	0.01
B1142	P 11+42.5	6.9 U	5744.90	2	0.00	90.00	1- 1	0.0- 4.5	09/25/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/01/90	4.5- 25.0	10/01/90	5	1.1	7	0.22	0.579	4.5- 25.0	10/01/90	0.90	0.04
							2- 1	25.0- 75.0	10/03/90	25.0- 75.0	10/03/90	25	0.2	7	0.04	0.013	25.0- 75.0	10/04/90	0.80	0.02
A1145	P 11+45.0	12.1 U	5743.10	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/03/90	5.5- 25.0	07/04/90	5	1.4	7	0.28	0.749	5.5- 25.0	07/04/90	2.40	0.12
							2- 1	25.0- 75.0	09/14/90	25.0- 75.0	09/14/90	25	3.8	7	0.76	0.254	25.0- 75.0	09/17/90	3.40	0.07
A1150	T 11+50.0	12.3 U	5740.00	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 1	5.5- 25.0	09/08/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1150	T 11+50.0	12.3	U 5740.00	1	0.00	90.00	2- 1	25.0- 75.0	09/21/90	25.0- 75.0	09/24/90	25	8.4	7	1.68	0.560	25.0- 75.0	09/24/90	7.10	0.14
B1152	S 11+52.5	7.5	U 5738.25	2	0.00	90.00	1- 1	0.0- 4.5	09/25/90	-	/ /						0.0- 75.0	10/15/90	7.80	0.10
							- 2	4.5- 25.0	10/02/90	4.5- 25.0	10/02/90	5	3.4	7	0.68	1.789	4.5- 25.0	10/02/90	1.00	0.05
							2- 1	25.0- 75.0	10/06/90	25.0- 75.0	10/08/90	25	1.6	7	0.32	0.107	25.0- 75.0	10/09/90	1.90	0.04
A1155	S 11+55.0	12.6	U 5736.50	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/05/90	5.5- 25.0	07/06/90	5	1.1	7	0.22	0.589	8.0- 25.0	07/06/90	1.10	0.06
							- 2	-	/ /	-	/ /						5.5- 25.0	07/06/90	0.30	0.02
							2- 1	25.0- 75.0	09/19/90	25.0- 75.0	09/20/90	25	0.4	7	0.08	0.027	25.0- 75.0	09/20/90	1.00	0.02
B1157	T 11+57	7.7	U 5735.00	2	0.00	90.00	1- 1	0.0- 4.5	10/02/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/02/90	4.5- 25.0	10/02/90	5	1.6	7	0.32	0.842	4.5- 25.0	10/02/90	1.20	0.06
							2- 1	25.0- 75.0	10/10/90	25.0- 75.0	10/10/90	25	0.5	7	0.10	0.033	25.0- 75.0	10/10/90	7.00	0.14
C1157	P 11+57.5	10.2	U 5735.00	3	0.00	90.00	1- 1	0.0- 4.5	10/05/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	10/11/90	4.5- 25.0	10/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	10/13/90	25.0- 75.0	10/13/90	25	0.3	7	0.06	0.020	25.0- 75.0	10/15/90	1.20	0.02
							3- 1	75.0-150.0	10/23/90	75.0-150.0	10/23/90	53.0	6.6	12	0.94	0.105	75.0-150.0	10/23/90	13.30	0.18
A1160	T 11+60.0	12.9	U 5733.00	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	09/08/90	5.5- 25.0	09/11/90	5	2.9	7	0.58	1.552	5.5- 25.0	09/12/90	4.20	0.22
							2- 1	25.0- 75.0	09/21/90	25.0- 75.0	09/21/90	25	65	12	6.50	3.570	25.0- 75.0	09/24/90	111.70	2.23
B1162	P 11+62.5	8.0	U 5731.20	2	0.00	90.00	1- 1	0.0- 5.5	07/28/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/30/90	5.5- 25.0	07/30/90	5	0.1	7	0.02	0.054	5.5- 25.0	07/31/90		
							2- 1	25.0- 75.0	08/03/90	25.0- 75.0	08/03/90	25	31.8	12	3.18	1.061	25.0- 75.0	08/03/90	59.40	1.19
A1165	P 11+65.0	13.1	U 5729.00	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	06/28/90	5.5- 25.0	06/28/90	5	0.01	7	0.00		5.5- 25.0	07/04/90	0.80	0.04
							2- 1	25.0- 75.0	07/13/90	25.0- 75.0	07/13/90	25	13.9	7	2.78	0.927	25.0- 75.0	07/14/90	37.20	0.74
B1167	T 11+67	8.3	U 5727.40	2	0.00	90.00	1- 1	0.0- 1.5	08/07/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/08/90	4.5- 25.0	08/08/90	5	0.01	7	0.00		1.5- 25.0	08/08/90	0.60	0.03
							2- 1	25.0- 75.0	08/09/90	25.0- 75.0	08/09/90	25	2.2	7	0.44	0.147	25.0- 75.0	08/09/90	1.80	0.04
A1170	T 11+70.0	13.4	U 5725.69	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/10/90	5.5- 25.0	07/12/90	5	01	7	0.20	0.535	5.5- 25.0	07/12/90	0.20	0.01
							2- 1	25.0- 75.0	07/26/90	25.0- 75.0	07/26/90	25	3.4	7	0.68	0.227	25.0- 75.0	07/27/90	8.70	0.17

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1172	S 11+72.5	8.5 U	5724.05	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	-	/ /						1.5- 25.0	08/01/90	2.50	0.11
							2- 1	25.0- 75.0	08/04/90	25.0- 75.0	08/06/90	25	14.6	7	2.92	0.974	25.0- 75.0	08/06/90	80.60	1.61
A1175	S 11+75.0	13.7 U	5722.38	1	0.00	90.00	1- 1	0.0- 5.5	06/25/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/05/90	5.5- 25.0	07/06/90	5	1.85	7	0.37	0.990	8.0- 25.0	07/06/90	0.60	0.04
							- 2	-	/ /	-	/ /						5.5- 25.0	07/06/90	0.10	0.01
							2- 1	25.0- 75.0	07/16/90	25.0- 75.0	07/20/90	25	16	12	3.20	1.068	25.0- 75.0	07/23/90	108.70	2.17
B1177	T 11+77	8.8 U	5720.70	2	0.00	90.00	1- 1	0.0- 4.5	08/07/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/08/90	1.5- 25.0	08/08/90	5	0.4	7	0.08	0.202	4.5- 25.0	08/08/90	0.40	0.02
							2- 1	25.0- 75.0	08/09/90	25.0- 75.0	08/09/90	25	1.6	7	0.32	0.107	25.0- 75.0	08/09/90	4.10	0.08
C1177	P 11+77.5	11.3 U	5720.70	3	0.00	90.00	1- 1	0.0- 4.5	08/09/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	08/11/90	4.5- 25.0	08/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/15/90	25.0- 75.0	08/15/90	25	0.4	7	0.08	0.027	25.0- 75.0	08/15/90	0.80	0.02
							3- 1	75.0-100.0	08/21/90	75.0-150.0	08/25/90	0.2	25.1	15	5.02	0.919	75.0-100.0	08/27/90	2.90	0.12
							- 2	100.0-150.0	08/28/90	100.0-150.0	08/28/90	53.0	2.4	15	0.48	0.070	100.0-150.0	08/29/90	3.10	0.06
A1180	T 11+80.0	13.9 U	5719.30	1	0.00	90.00	1- 1	0.0- 3.5	06/25/90	-	/ /						-	/ /		
							- 2	3.5- 25.0	07/10/90	3.5- 25.0	07/12/90	5	9	7	1.80	4.664	3.5- 25.0	07/12/90	58.40	2.72
							2- 1	25.0- 75.0	07/26/90	25.0- 75.0	07/26/90	25	3.5	7	0.70	0.234	25.0- 75.0	07/27/90	4.80	0.10
C1182	T 11+82	11.5 U/S	5717.95	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	-	/ /						-	/ /		
							2- 1	25.0- 75.0	09/05/90	25.0- 75.0	09/05/90	25	4	7	0.80	0.267	25.0- 75.0	09/06/90	0.60	0.01
B1182	P 11+82.5	9.1 U	5717.90	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	0.4	7	0.08	0.202	1.5- 25.0	07/31/90	0.30	0.01
							2- 1	25.0- 75.0	08/03/90	25.0- 75.0	08/03/90	25	6.2	12	0.62	0.207	25.0- 75.0	08/03/90	4.40	0.09
A1185	P 11+85.0	14.2 U	5716.10	1	0.00	90.00	1- 1	0.0- 3.5	06/25/90	-	/ /						-	/ /		
							- 2	3.5- 25.0	06/28/90	3.5- 25.0	06/28/90	5	3.9	7	0.78	2.021	8.0- 25.0	07/03/90	1.00	0.06
							- 2	-	/ /	-	/ /						3.5- 25.0	07/04/90	1.80	0.08
							2- 1	25.0- 75.0	07/13/90	25.0- 75.0	07/13/90	25	5.8	7	1.16	0.387	25.0- 75.0	07/14/90	7.80	0.16
C1187	S 11+87.5	11.8 U	5714.30	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.3	7	0.06	0.443	-	/ /		
							2- 1	25.0- 75.0	08/16/90	25.0- 75.0	08/17/90	25	0.7	7	0.14	0.047	25.0- 75.0	08/17/90	0.80	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1190	T 11+90.0	14.5 U	5712.40	1	0.00	90.00	1- 1	0.0- 2.5	06/25/90	-	/ /						-	/ /		
							- 2	2.5- 25.0	07/10/90	2.5- 25.0	07/12/90	5	01	7	0.20	0.512	2.5- 25.0	07/12/90	1.10	0.05
							2- 1	25.0- 75.0	07/26/90	25.0- 75.0	07/26/90	25	4.1	7	0.82	0.274	25.0- 75.0	07/26/90	25.20	0.50
B1192	S 11+92.5	9.6 U	5713.00	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	1.5- 25.0	07/31/90	5	0.95	7	0.19	0.481	1.5- 25.0	08/01/90	4.40	0.19
							2- 1	25.0- 75.0	08/04/90	25.0- 75.0	08/04/90	25	4.0	7	0.80	0.267	25.0- 75.0	08/06/90	7.20	0.14
A1195	S 11+95.0	14.7 U	5711.80	1	0.00	90.00	1- 1	0.0- 2.5	06/25/90	-	/ /						-	/ /		
							- 2	2.5- 25.0	07/05/90	1.5- 25.0	07/05/90	5	0.01	7	0.00		8.0- 25.0	07/06/90	3.30	0.19
							- 2	-	/ /	-	/ /						3.5- 25.0	07/06/90	1.60	0.07
							2- 1	25.0- 75.0	07/16/90	25.0- 75.0	07/19/90	25	2.3	7	0.46	0.153	25.0- 75.0	07/21/90	3.00	0.06
C1197	P 11+97.5	12.4 U	5708.80	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	0.3	7	0.06	0.443	-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/15/90	25	2.2	7	0.44	0.147	25.0- 75.0	08/15/90	6.60	0.13
							3- 1	75.0- 90.0	08/21/90	75.0-150.0	08/25/90	2	26.5	15	5.30	0.971	75.0-150.0	08/25/90	118.30	1.58
							- 2	90.0-150.0	08/28/90	90.0-150.0	08/28/90	53.0	3.5	15	0.70	0.091	90.0-150.0	08/28/90	11.00	0.18
A1200	T 12+00.0	15.0 U	5707.30	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/10/90	1.5- 25.0	07/11/90	5	0.1	7	0.02	0.051	1.5- 25.0	07/12/90	0.30	0.01
B1202	P 12+02.5	10.0 U	5704.90	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	0.2	7	0.04	0.101	1.5- 25.0	07/31/90	0.50	0.02
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/03/90	25	5.2	7	1.04	0.348	25.0- 75.0	08/03/90	1.90	0.04
A1205	P 12+05.0	15.0 U	5703.50	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/28/90	-	/ /						8.0- 25.0	07/03/90	0.40	0.02
							- 2	-	/ /	-	/ /						1.5- 25.0	07/03/90	1.20	0.05
							2- 1	25.0- 75.0	07/13/90	25.0- 75.0	07/13/90	25	14.2	7	2.84	0.950	25.0- 75.0	07/18/90	67.90	1.36
C1207	S 12+07.5	12.5 U	5702.40	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.1	7	0.02	0.148	-	/ /		
							2- 1	25.0- 75.0	08/16/90	25.0- 75.0	08/17/90	25	0.2	7	0.04	0.013	25.0- 75.0	08/17/90	1.20	0.02
A1210	T 12+10.0	15.0 U	5701.00	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/10/90	1.5- 25.0	07/11/90	5	5.2	7	1.04	2.632	1.5- 25.0	07/12/90	4.50	0.19
							2- 1	25.0- 75.0	07/25/90	25.0- 75.0	07/26/90	25	3.9	7	0.78	0.261	25.0- 75.0	07/26/90	2.40	0.05
C1212	T 12+12	12.5 U/S	5700.80	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1212	T 12+12	12.5 U/S	5700.80	3	0.00	90.00	1- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	09/05/90	25.0- 75.0	09/05/90	25	55	7	11.00	3.681	25.0- 75.0	09/06/90	1.20	0.02
B1212	S 12+12.5	10.0 U	5700.00	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	1.5- 25.0	07/31/90	5	01	7	0.20	0.506	1.5- 25.0	08/01/90	0.20	0.01
							2- 1	25.0- 75.0	08/04/90	25.0- 75.0	08/04/90	25	1.4	7	0.28	0.094	25.0- 75.0	08/06/90	1.10	0.02
A1215	S 12+15.0	15.0 U	5698.50	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/05/90	1.5- 25.0	07/05/90	5	0.01	7	0.00		1.5- 25.0	07/09/90	11.00	0.47
							2- 1	25.0- 35.0	07/19/90	25.0- 35.0	07/19/90	25	26.1	15	5.22	17.339	25.0- 35.0	07/20/90	298.70	29.87
							- 1	-	/ /	-	/ /						25.0- 75.0	07/21/90		
							- 2	35.0- 75.0	07/21/90	35.0- 75.0	07/21/90	25	1.2	7	0.24	0.091	35.0- 75.0	07/21/90	1.80	0.05
C1217	P 12+17.5	12.5 U	5697.00	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	0.1	7	0.02	0.148	-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/15/90	25	1.5	7	0.30	0.100	25.0- 75.0	08/15/90	0.70	0.01
							3- 1	75.0-150.0	08/21/90	75.0-150.0	08/25/90	53.0	3.8	15	0.76	0.107	75.0-150.0	08/25/90	9.80	0.13
A1220	T 12+20.0	15.0 U	5695.28	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/10/90	1.5- 25.0	07/10/90	5	4.0	7	0.80	2.025	8.0- 25.0	07/12/90	1.00	0.06
							- 2	-	/ /	-	/ /						1.5- 25.0	07/12/90	0.20	0.01
							2- 1	25.0- 75.0	07/25/90	25.0- 75.0	07/26/90	25	0.4	7	0.08	0.027	25.0- 75.0	07/26/90	0.70	0.01
C1222	T 12+22	12.5 U/S	5693.61	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.3	7	0.06	0.443	-	/ /		
							2- 1	25.0- 75.0	09/05/90	25.0- 75.0	09/05/90	25	1.4	7	0.28	0.094	25.0- 75.0	09/06/90	1.40	0.03
B1222	P 12+22.5	10.0 U	5693.60	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	1.5	7	0.30	0.759	1.5- 25.0	07/31/90	0.40	0.02
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/03/90	25	3.1	7	0.62	0.207	25.0- 75.0	08/03/90	1.10	0.02
A1225	P 12+25.0	15.0 U	5692.05	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/27/90	1.5- 25.0	06/28/90	5	5.6	7	1.12	2.835	8.0- 25.0	07/03/90	3.80	0.22
							- 2	-	/ /	-	/ /						1.5- 25.0	07/03/90	3.60	0.15
							2- 1	25.0- 75.0	07/13/90	25.0- 75.0	07/13/90	25	17.8	7	3.56	1.191	25.0- 75.0	07/19/90	246.80	4.94
B1227	T 12+27	10 U/S	5690.50	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	0.01	7	0.00		1.5- 25.0	08/09/90	0.40	0.02
C1227	S 12+27.5	12.5 U	5690.50	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1227	S 12+27.5	12.5 U	5690.50	3	0.00	90.00	1- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/16/90	25.0- 75.0	08/16/90	25	0.1	7	0.02	0.007	25.0- 75.0	08/17/90	1.00	0.02
A1230	T 12+30.0	15.0 U	5687.68	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/10/90	5	0.5	7	0.10	0.253	8.0- 25.0	07/12/90	1.80	0.11
							- 2	-	/ /	-	/ /						1.5- 25.0	07/12/90		
							2- 1	25.0- 75.0	07/25/90	25.0- 75.0	07/26/90	25	4.9	7	0.98	0.328	25.0- 75.0	07/26/90	3.40	0.07
C1232	T 12+32	12.5 U/S	5686.69	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	09/05/90	25.0- 75.0	09/05/90	25	1.02	7	0.20	0.067	25.0- 75.0	09/06/90	1.90	0.04
B1232	S 12+32.5	10.0 U	5686.69	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	-	/ /						1.5- 25.0	08/01/90	19.80	0.84
							2- 1	25.0- 75.0	08/04/90	25.0- 75.0	08/04/90	25	1.0	7	0.20	0.067	25.0- 75.0	08/04/90	1.70	0.03
A1235	S 12+35.0	15.0 U	5683.30	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/05/90	1.5- 25.0	07/05/90	5	6.8	7	1.36	3.442	1.5- 25.0	07/07/90	19.10	0.81
							2- 1	25.0- 75.0	07/19/90	25.0- 75.0	07/19/90	25	2.2	7	0.44	0.147	25.0- 75.0	07/19/90	11.10	0.22
B1237	T 12+37	10 U/S	5679.90	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	5.0	7	1.00	2.531	1.5- 25.0	08/09/90	45.00	1.91
C1237	P 12+37.5	12.5 U	5679.90	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/14/90	25	0.8	7	0.16	0.054	25.0- 75.0	08/15/90	1.10	0.02
							3- 1	75.0-150.0	08/20/90	75.0-150.0	08/21/90	43	5.15	15	1.03	0.145	75.0-150.0	08/27/90	1.10	0.01
A1240	T 12+40.0	15.0 U	5677.33	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/10/90	5	4.1	7	0.82	2.076	8.0- 25.0	07/12/90	0.40	0.02
							- 2	-	/ /	-	/ /						1.5- 25.0	07/12/90		
							2- 1	25.0- 75.0	07/24/90	25.0- 75.0	07/26/90	25	2.2	7	0.44	0.147	25.0- 75.0	07/28/90	1.20	0.02
C1242	T 12+42	12.5 U/S	5675.92	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.01	7	0.00		-	/ /		
B1242	P 12+42.5	10.0 U	5671.90	2	0.00	90.00	1- 1	0.0- 1.5	07/28/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	2.6	7	0.52	1.316	8.0- 25.0	07/31/90	1.30	0.08
							- 2	-	/ /	-	/ /						1.5- 25.0	07/31/90	4.50	0.19
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/02/90	25	0.3	7	0.06	0.020	25.0- 75.0	08/03/90	0.70	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1245	Q 12+45	10 U/S	5671.35	2	60.00	90.00	1- 1	0.0- 10.0	08/27/90	1.0- 10.0	08/28/90	2	0.01	7	0.00		1.0- 10.0	08/28/90		
A1245	P 12+45.0	15.0 U	5671.35	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/27/90	1.5- 25.0	06/28/90	5	1.3	7	0.26	0.658	8.0- 25.0	07/03/90	0.90	0.05
							- 2	-	/ /	-	/ /						1.5- 25.0	07/03/90	38.60	1.64
							2- 1	25.0- 75.0	07/13/90	25.0- 75.0	07/13/90	25	15.7	7	3.14	1.051	25.0- 75.0	07/17/90	6.50	0.13
B1247	T 12+47	10 U/S	5670.80	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	0.2	28.1	7	5.62	21.287	1.5- 25.0	08/08/90	118.80	5.06
C1247	S 12+47.5	12.5 U	5670.80	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.02	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/16/90	25.0- 75.0	08/16/90	25	0.1	7	0.02	0.007	25.0- 75.0	08/17/90	0.80	0.02
A1250	T 12+50.0	15.0 U	5669.93	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/10/90	5	6.0	7	1.20	3.037	8.0- 25.0	07/11/90	4.70	0.28
							- 2	-	/ /	-	/ /						1.5- 25.0	07/12/90	0.20	0.01
							2- 1	25.0- 75.0	07/24/90	25.0- 75.0	07/25/90	25	18.5	7	3.70	1.269	25.0- 75.0	07/27/90	35.50	0.71
C1252	T 12+52	12.5 U/S	5669.50	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.07	7	0.01	0.074	-	/ /		
B1252	S 12+52.5	10.0 U	5669.50	2	0.00	90.00	1- 1	0.0- 1.5	07/27/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	1.5- 25.0	07/31/90	5	2.4	7	0.48	1.215	1.5- 25.0	08/01/90	110.80	4.71
							2- 1	25.0- 75.0	08/04/90	25.0- 75.0	08/04/90	25	1.3	7	0.26	0.089	25.0- 75.0	08/04/90	1.80	0.04
A1255	S 12+55.0	15.0 U	5668.50	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/05/90	1.5- 25.0	07/05/90	5	0.01	7	0.00		1.5- 25.0	07/07/90	40.50	1.72
							2- 1	25.0- 75.0	07/19/90	25.0- 75.0	07/19/90	25	2.2	7	0.44	0.151	25.0- 75.0	07/20/90	1.50	0.03
B1257	T 12+57	10 U/S	5667.50	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	0.2	7	0.04	0.101	1.5- 25.0	08/09/90	0.70	0.03
C1257	P 12+57.5	12.5 U	5667.50	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	0.1	7	0.02	0.148	-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/14/90	25	0.5	7	0.10	0.034	25.0- 75.0	08/15/90	0.80	0.02
							3- 1	75.0-150.0	08/20/90	75.0-150.0	08/21/90	18	20	15	2.86	0.781	75.0-150.0	08/25/90	57.70	0.77
A1260	T 12+60.0	15.0 U	5662.20	1	0.00	90.00	1- 1	0.0- 1.5	06/25/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/10/90	5	11.2	7	2.24	5.670	1.5- 25.0	07/11/90	13.20	0.56

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1260	T 12+60.0	15.0 U	5662.20	1	0.00	90.00	2- 1	25.0- 40.0	07/24/90	25.0- 40.0	07/25/90	25	10.2	12	2.04	2.302	25.0- 40.0	07/26/90	9.10	0.61
							- 2	40.0- 50.0	07/27/90	40.0- 50.0	07/27/90	25	33.0	12	3.30	7.326	40.0- 50.0	07/27/90	47.30	4.73
							- 3	50.0- 75.0	07/28/90	50.0- 75.0	07/28/90	25	1.2	7	0.24	0.126	50.0- 75.0	07/28/90	1.40	0.06
B1262	P 12+62.5	10.0 U	5663.75	2	0.00	90.00	1- 1	0.0- 1.5	07/27/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	0.7	7	0.14	0.354	1.5- 25.0	07/30/90	0.80	0.03
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/02/90	25	1.0	7	0.20	0.069	25.0- 75.0	08/03/90	0.90	0.02
A1265	P 12+65.0	15.0 U	5661.20	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/27/90	1.5- 25.0	06/28/90	5	4.5	7	0.90	2.278	1.5- 25.0	06/29/90	23.70	1.01
							2- 1	25.0- 75.0	07/13/90	25.0- 75.0	07/13/90	25	5.8	7	1.16	0.398	25.0- 75.0	07/14/90	16.20	0.32
B1267	T 12+67	10 U/S	5660.00	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	8.3	7	1.66	4.202	8.0- 25.0	08/08/90	12.10	0.71
							- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	2.30	0.10
C1267	S 12+67.5	12.5 U	5660.00	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.1	7	0.02	0.148	-	/ /		
							2- 1	25.0- 75.0	08/17/90	25.0- 75.0	08/17/90	25	0.01	7	0.00		25.0- 75.0	08/17/90	0.80	0.02
A1270	T 12+70.0	15.0 U	5658.50	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/10/90	5	0.4	7	0.08	0.202	1.5- 25.0	07/11/90	32.20	1.37
							2- 1	25.0- 75.0	07/24/90	25.0- 75.0	07/24/90	25	3.2	12	0.32	0.110	25.0- 75.0	07/26/90	43.70	0.87
C1272	T 12+72	12.5	5658.28	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	1.0	7	0.20	0.506	1.5- 25.0	08/31/90	0.40	0.02
							2- 1	25.0- 75.0	09/05/90	25.0- 75.0	09/05/90	25	1.0	7	0.20	0.069	25.0- 75.0	09/06/90	3.00	0.06
B1272	S 12+72.5	10.0 U	5658.20	2	0.00	90.00	1- 1	0.0- 1.5	07/27/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	1.5- 25.0	07/31/90	5	2.8	7	0.56	1.417	8.0- 25.0	08/01/90	36.90	2.17
							- 2	-	/ /	-	/ /						1.5- 25.0	08/01/90	2.00	0.09
							2- 1	25.0- 75.0	08/04/90	25.0- 75.0	08/04/90	25	1.0	7	0.20	0.069	25.0- 75.0	08/04/90	1.40	0.03
A1275	S 12+75.0	15.0 U	5655.00	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/04/90	1.5- 25.0	07/05/90	5	0.1	7	0.02	0.051	1.5- 25.0	07/06/90	7.80	0.33
							2- 1	25.0- 60.0	07/19/90	25.0- 60.0	07/19/90	25	7.1	15	1.42	0.700	25.0- 60.0	07/20/90	10.00	0.29
							- 2	60.0- 75.0	07/21/90	60.0- 75.0	07/21/90	25	1.2	7	0.24	0.190	60.0- 75.0	07/21/90	0.60	0.04
B1277	T 12+77	10 U/S	5652.80	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	5.5	7	1.10	2.784	8.0- 25.0	08/08/90	0.60	0.04

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1277	T 12+77	10 U/S	5652.80	2	0.00	90.00	1- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	0.40	0.02
C1277	P 12+77.5	12.5 U	5652.80	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	4.5	7	0.90	2.278	1.5- 25.0	08/11/90	3.40	0.14
							2- 1	25.0- 50.0	08/14/90	25.0- 50.0	08/14/90	25	27.5	7	5.50	7.079	25.0- 50.0	08/15/90	141.20	5.65
							- 2	50.0- 75.0	08/16/90	50.0- 75.0	08/16/90	25	0.4	10	0.08	0.042	50.0- 75.0	08/16/90	1.00	0.04
							3- 1	75.0-150.0	08/18/90	75.0-150.0	08/20/90	43	4.3	15	0.86	0.130	75.0-150.0	08/25/90	2.70	0.04
A1280	T 12+80.0	15.0 U	5649.00	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/10/90	5	0.01	7	0.00		8.0- 25.0	07/11/90	0.20	0.01
							- 2	-	/ /	-	/ /						1.5- 25.0	07/11/90	0.50	0.02
							2- 1	25.0- 50.0	07/24/90	25.0- 75.0	07/24/90	25	13.8	7	2.76	0.947	25.0- 50.0	07/26/90	77.20	3.09
							- 2	50.0- 75.0	07/27/90	50.0- 75.0	07/27/90	25	3.3	7	0.66	0.347	50.0- 75.0	07/28/90	50.80	2.03
C1282	T 12+82	12.5 U/S	5648.59	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.5	7	0.10	0.253	1.5- 25.0	08/31/90	0.90	0.04
							2- 1	25.0- 75.0	09/05/90	25.0- 75.0	09/05/90	25	3.2	7	0.64	0.220	25.0- 75.0	09/05/90	1.70	0.03
B1282	P 12+82.5	10.0 U	5648.50	2	0.00	90.00	1- 1	0.0- 1.5	07/27/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	0.01	7	0.00		1.5- 25.0	07/30/90	0.40	0.02
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/02/90	25	0.8	7	0.16	0.055	25.0- 75.0	08/03/90	1.30	0.03
A1285	P 12+85.0	15.0 U	5645.30	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/27/90	1.5- 25.0	06/28/90	5	0.01	7	0.00		1.5- 25.0	06/29/90	13.10	0.56
							2- 1	25.0- 75.0	07/12/90	25.0- 75.0	07/13/90	25.0	1.2	7	0.24	0.082	25.0- 75.0	07/14/90	1.20	0.02
B1287	T 12+87	10 U/S	5644.00	2	0.00	90.00	1- 1	0.0- 4.5	08/06/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	08/07/90	4.5- 25.0	08/07/90	5	1.0	7	0.20	0.526	8.0- 25.0	08/08/90	0.70	0.04
							- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	3.00	0.13
C1287	S 12+87.5	12.5 U	5644.00	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.8	7	0.16	0.405	1.5- 25.0	08/13/90	4.90	0.21
							2- 1	25.0- 75.0	08/17/90	25.0- 75.0	08/17/90	25	0.5	7	0.10	0.034	25.0- 75.0	08/17/90	2.00	0.04
C1290	Q 12+90	12.5 U/S	5641.50	3	0.00	90.00	1- 1	0.0- 25.0	09/06/90	1.5- 25.0	09/07/90	5	0.01	7	0.00		-	/ /		
A1290	T 12+90.0	15.0 U	5641.50	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/09/90	5	0.01	7	0.00		8.0- 25.0	07/11/90	0.40	0.02
							- 2	-	/ /	-	/ /						1.5- 25.0	07/11/90	0.40	0.02
							2- 1	25.0- 75.0	07/24/90	25.0- 75.0	07/24/90	25	1.2	7	0.24	0.082	25.0- 75.0	07/26/90	0.50	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1292	T 12+92	12.5 U/S	5640.62	3	0.00	90.00	1- 1	0.0- 4.5	08/29/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	08/30/90	-	/ /						4.5- 25.0	08/31/90	12.10	0.59
							2- 1	25.0- 75.0	09/04/90	25.0- 75.0	09/05/90	25	0.7	7	0.14	0.048	25.0- 75.0	09/05/90	0.60	0.01
B1292	S 12+92.5	10.0 U	5640.60	2	0.00	90.00	1- 1	0.0- 1.5	07/27/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	5.5- 25.0	07/31/90	5	01	7	0.20	0.535	8.0- 25.0	08/01/90	18.60	1.09
							- 2	-	/ /	-	/ /						1.5- 25.0	08/01/90	23.80	1.01
							2- 1	25.0- 75.0	08/03/90	25.0- 75.0	08/04/90	25	1.5	7	0.30	0.103	25.0- 75.0	08/04/90	1.30	0.03
C1295	Q 12+95	12.5 U/S	5638.90	3	0.00	90.00	1- 1	0.0- 2.5	09/06/90	-	/ /						-	/ /		
							- 2	2.5- 25.0	09/06/90	1.5- 25.0	09/07/90	5	1.5	7	0.30	0.759	8.0- 25.0	09/07/90	0.50	0.03
							- 2	-	/ /	-	/ /						1.5- 25.0	09/07/90	0.20	0.01
A1295	S 12+95.0	15.0 U	5636.50	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/04/90	5.5- 25.0	07/05/90	5	0.01	7	0.00		1.5- 25.0	07/06/90	44.70	1.90
							2- 1	25.0- 40.0	07/18/90	25.0- 40.0	07/18/90	25	30.1	7	6.02	6.794	25.0- 40.0	07/19/90	41.00	2.73
							- 2	40.0- 75.0	07/21/90	40.0- 75.0	07/21/90	25	3.4	7	0.68	0.290	40.0- 75.0	07/21/90	4.80	0.14
B1297	T 12+97	10 U/S	5635.20	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	1.8	7	0.36	0.911	8.0- 25.0	08/08/90	0.50	0.03
							- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	0.40	0.02
C1297	P 12+97.5	12.5 U	5635.20	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/14/90	25	1.3	7	0.26	0.089	25.0- 75.0	08/15/90	4.00	0.08
							3- 1	75.0-150.0	08/18/90	75.0-150.0	08/20/90	43	4.6	15	0.92	0.139	75.0-150.0	08/25/90	14.70	0.20
C1300	Q 13+00	12.5 U/S	5631.50	3	0.00	90.00	1- 1	0.0- 1.5	10/03/90	-	/ /						-	/ /		
							3- 1	1.5- 90.0	10/04/90	-	/ /						75.0- 90.0	10/05/90	1.50	0.10
							- 1	90.0-110.0	10/09/90	-	/ /						-	/ /		
							- 3	110.0-150.0	10/11/90	-	/ /						110.0-150.0	10/16/90	0.30	0.01
A1300	T 13+00.0	15.0 U	5631.50	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/09/90	5	01	7	0.20	0.506	8.0- 25.0	07/11/90	2.50	0.15
							- 2	-	/ /	-	/ /						1.5- 25.0	07/11/90	0.70	0.03
							2- 1	25.0- 75.0	07/23/90	25.0- 75.0	07/24/90	25	0.9	7	0.18	0.079	25.0- 75.0	07/26/90	1.30	0.03
C1302	T 13+02	12.5 U/S	5631.83	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	0.6	7	0.12	0.304	1.5- 25.0	08/31/90	0.40	0.02
							2- 1	25.0- 75.0	09/04/90	25.0- 75.0	09/05/90	25	0.9	7	0.18	0.079	25.0- 75.0	09/05/90	0.60	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
D1302	P 13+02	5 U/S	5631.00	4	0.00	90.00	1- 1	0.0- 1.5	08/27/90	-	/ /						-	/ /		
							- 2	1.5- 10.0	08/29/90	1.5- 10.0	08/29/90	2	8.1	7	1.62	22.870	1.5- 10.0	08/31/90	1.20	0.14
B1302	P 13+02.5	10.0 U	5631.00	2	0.00	90.00	1- 2	1.5- 25.0	07/30/90	1.5- 25.0	07/30/90	5	0.01	7	0.00		1.5- 25.0	07/30/90	0.60	0.03
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/02/90	25	0.7	7	0.14	0.062	25.0- 75.0	08/03/90	1.40	0.03
C1305	Q 13+05	12.5 U/S	5629.50	3	0.00	90.00	1- 1	0.0- 1.5	10/03/90	-	/ /						-	/ /		
							3- 1	1.5-110.0	10/17/90	-	/ /						105.0-110.0	10/22/90	9.40	1.88
							- 2	110.0-118.0	10/24/90	-	/ /						112.0-118.0	10/26/90	7.30	1.22
							- 3	118.0-150.0	10/29/90	-	/ /						118.0-150.0	10/30/90	20.00	0.63
A1305	P 13+05.0	15.0 U	5629.50	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/27/90	1.5- 25.0	06/28/90	5	0.3	7	0.06	0.152	1.5- 25.0	06/29/90	63.50	2.70
							2- 1	25.0- 30.0	07/12/90	25.0- 30.0	07/12/90	8	11.2	7	2.24	9.701	25.0- 30.0	07/13/90	144.00	28.80
							- 2	30.0- 50.0	07/16/90	30.0- 50.0	07/16/90	5	25.1	7	3.59	6.905	30.0- 50.0	07/16/90	210.00	10.50
							- 3	50.0- 75.0	07/17/90	50.0- 75.0	07/17/90	22	22	15	2.20	3.534	50.0- 75.0	07/17/90	95.00	3.80
B1307	T 13+07	10 U/S	5628.40	2	0.00	90.00	1- 2	1.5- 25.0	08/07/90	1.5- 25.0	08/07/90	5	0.3	7	0.06	0.152	8.0- 25.0	08/08/90	0.80	0.05
							- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	1.80	0.08
D1307	P 13+07	6.5 U/S	5628.00	4	0.00	90.00	1- 1	0.0- 1.5	08/27/90	-	/ /						-	/ /		
							- 2	1.5- 10.0	08/29/90	1.5- 10.0	08/29/90	2	25.3	7	5.06	99.717	1.5- 10.0	08/31/90	25.40	2.99
C1307	S 13+07.5	12.5 U	5628.40	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.1	7	0.02	0.148	-	/ /		
							2- 1	25.0- 75.0	08/16/90	25.0- 75.0	08/16/90	25	1.3	7	0.26	0.115	25.0- 75.0	08/17/90	1.00	0.02
C1310	Q 13+10	12.5 U/S	5626.90	3	0.00	90.00	1- 1	0.0- 1.5	10/03/90	-	/ /						-	/ /		
							3- 1	1.5-100.0	10/04/90	-	/ /						75.0-100.0	10/05/90	3.80	0.15
							- 2	100.0-150.0	10/09/90	-	/ /						100.0-150.0	10/10/90	1.90	0.04
A1310	T 13+10.0	15.0 U	5626.90	1	0.00	90.00	1- 1	0.0- 5.5	06/23/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/09/90	1.5- 25.0	07/09/90	5	01	7	0.20	0.506	8.0- 25.0	07/11/90	0.60	0.04
							- 2	-	/ /	-	/ /						1.5- 25.0	07/11/90	0.20	0.01
							2- 1	25.0- 75.0	07/23/90	25.0- 75.0	07/24/90	25	0.7	7	0.14	0.062	25.0- 75.0	07/25/90	1.20	0.02
C1312	T 13+12	12.5 U/S	5626.71	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	2.3	7	0.46	1.164	1.5- 25.0	08/31/90	0.40	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1312	S 13+12.5	10.0 U	5626.70	2	0.00	90.00	1- 1	0.0- 1.5	07/27/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/31/90	1.5- 20.0	07/31/90	5	19.4	12	1.94	6.795	8.0- 25.0	08/01/90	179.90	10.58
							- 2	-	/ /	-	/ /						1.5- 25.0	08/01/90	3.60	0.15
							2- 1	25.0- 75.0	08/03/90	25.0- 75.0	08/04/90	25	0.2	7	0.04	0.018	25.0- 75.0	08/04/90	1.30	0.03
C1315	Q 13+15	12.5 U/S	5625.20	3	0.00	90.00	1- 1	0.0- 1.5	10/03/90	-	/ /						-	/ /		
							3- 1	1.5-150.0	10/18/90	-	/ /						75.0-150.0	10/18/90	10.90	0.15
A1315	S 13+15.0	15.0 U	5625.20	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/04/90	1.5- 25.0	07/05/90	5	0.01	7	0.00		1.5- 25.0	07/06/90	27.00	1.15
							2- 1	25.0- 75.0	07/18/90	25.0- 75.0	07/18/90	25	0.3	7	0.06	0.026	25.0- 75.0	07/19/90	4.30	0.09
B1317	T 13+17	10 U/S	5624.20	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	-	/ /						8.0- 25.0	08/08/90	0.40	0.02
							- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	0.20	0.01
C1317	P 13+17.5	12.5 U	5624.20	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/11/90	1.5- 25.0	08/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/14/90	25	0.3	7	0.06	0.026	25.0- 75.0	08/15/90	1.10	0.02
							3- 1	75.0-150.0	08/18/90	75.0-150.0	08/20/90	43	2.9	15	0.58	0.114	75.0-150.0	08/21/90	18.10	0.24
A1318	Q 13+18	10 U/S	5623.80	1	0.00	90.00	1- 1	0.0- 10.0	08/27/90	-	/ /						1.0- 10.0	08/31/90	0.20	0.02
B1320	Q 13+20	10 U/S	5622.90	2	0.00	90.00	1- 1	0.0- 10.0	08/27/90	-	/ /						1.0- 10.0	08/28/90	0.40	0.04
A1320	T 13+20.0	15.0 U	5622.90	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	07/09/90	1.5- 25.0	07/09/90	5	0.5	7	0.10	0.253	1.5- 25.0	07/10/90	59.10	2.51
							2- 1	25.0- 75.0	07/23/90	25.0- 75.0	07/24/90	25	1.1	7	0.22	0.097	25.0- 75.0	07/25/90	0.80	0.02
B1322	P 13+22.5	10.0 U	5619.90	2	0.00	90.00	1- 1	0.0- 2.5	07/27/90	-	/ /						-	/ /		
							- 2	2.5- 25.0	07/30/90	2.5- 25.0	07/30/90	5	0.01	7	0.00		2.5- 25.0	07/30/90	1.10	0.05
							2- 1	25.0- 75.0	08/02/90	25.0- 75.0	08/02/90	25	0.01	7	0.00		25.0- 75.0	08/03/90	0.70	0.01
A1325	P 13+25.0	15.0 U	5618.85	1	0.00	90.00	1- 1	0.0- 1.5	06/23/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	06/27/90	1.5- 25.0	06/28/90	5	1.7	7	0.34	0.861	8.0- 25.0	06/28/90	11.00	0.65
							2- 1	25.0- 75.0	07/12/90	25.0- 75.0	07/12/90	25	1.8	7	0.36	0.159	25.0- 75.0	07/13/90	1.20	0.02
B1327	T 13+27	10 U/S	5617.80	2	0.00	90.00	1- 1	0.0- 1.5	08/06/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/07/90	-	/ /						8.0- 25.0	08/08/90	0.60	0.04
							- 2	-	/ /	-	/ /						1.5- 25.0	08/08/90	0.90	0.04

Table 6 (Continued)

								DRILLING DATA		WATER PRESSURE TEST DATA							GROUTING DATA			
HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DEPTH (FT)	DATE COMPLETED	DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1327	S 13+27.5	12.5 U	5617.80	3	0.00	90.00	1- 1	0.0- 1.5	08/09/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/13/90	1.5- 25.0	08/13/90	5	0.3	7	0.06	0.443	-	/ /		
							2- 1	25.0- 75.0	08/16/90	25.0- 75.0	08/16/90	25	0.01	7	0.00		25.0- 75.0	08/17/90	0.80	0.02
A1330	T 13+30.0	15.0 U	5611.80	1	0.00	90.00	1- 1	0.0- 5.5	06/23/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/09/90	5.5- 25.0	07/09/90	5	0.2	7	0.04	0.107	5.5- 25.0	07/10/90	1.20	0.06
							2- 1	25.0- 75.0	07/23/90	25.0- 75.0	07/23/90	25	0.8	7	0.16	0.071	25.0- 75.0	07/25/90	0.80	0.02
C1332	T 13+32	12.5 U/S	5613.80	3	0.00	90.00	1- 1	0.0- 1.5	08/29/90	-	/ /						-	/ /		
							- 2	1.5- 25.0	08/30/90	1.5- 25.0	08/30/90	5	1.2	7	0.24	0.607	1.5- 25.0	08/31/90	0.30	0.01
B1332	S 13+32.5	10.0 U	5613.80	2	0.00	90.00	1- 1	0.0- 5.5	07/27/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/31/90	5.5- 25.0	07/31/90	5	1.7	7	0.34	0.910	1.5- 25.0	08/01/90	54.80	2.33
							2- 1	25.0- 75.0	08/03/90	25.0- 75.0	08/04/90	25	0.1	7	0.02	0.009	25.0- 75.0	08/04/90	0.30	0.01
A1335	S 13+35.0	15.0 U	5612.90	1	0.00	90.00	1- 1	0.0- 5.5	06/23/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/04/90	1.5- 25.0	07/05/90	5	4.0	7	0.80	2.025	5.5- 25.0	07/05/90	5.20	0.27
							2- 1	25.0- 75.0	07/18/90	25.0- 75.0	07/18/90	25	5.1	7	1.02	0.450	25.0- 75.0	07/18/90	21.40	0.43
A1336	Q 13+36	15 U/S	5611.50	1	0.00	90.00	1- 1	0.0- 10.0	08/27/90	1.0- 10.0	08/28/90	2	0.2	7	0.04	0.558	1.0- 10.0	08/28/90	0.20	0.02
B1337	T 13+37	10 U/S	5610.50	2	0.00	90.00	1- 1	0.0- 4.5	08/06/90	-	/ /						0.0- 1.5	08/06/90	5.10	3.40
							- 2	4.5- 25.0	08/07/90	4.5- 25.0	08/07/90	5	0.6	7	0.12	0.316	5.5- 25.0	08/08/90	0.70	0.04
C1337	P 13+37.5	12.5 U	5612.90	3	0.00	90.00	1- 1	0.0- 4.5	08/09/90	-	/ /						-	/ /		
							- 2	4.5- 25.0	08/11/90	4.5- 25.0	08/11/90	5	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	08/14/90	25.0- 75.0	08/14/90	25	0.4	7	0.08	0.035	25.0-100.0	08/15/90	0.40	0.01
							3- 1	75.0-150.0	08/18/90	75.0-150.0	08/20/90	43	04	15	0.80	0.158	75.0-150.0	08/21/90	0.40	0.01
A1339	P 13+39	15 U/S	5609.20	1	0.00	90.00	1- 1	0.0- 10.0	08/27/90	1.0- 10.0	08/28/90	2	0.01	7	0.00		1.0- 10.0	08/28/90	0.10	0.01
A1340	T 13+40.0	15.0 U	5608.80	1	0.00	90.00	1- 1	0.0- 5.5	06/23/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	07/09/90	5.5- 25.0	07/09/90	5	0.4	7	0.08	0.214	5.5- 25.0	07/10/90	0.70	0.04
							2- 1	25.0- 75.0	07/23/90	25.0- 75.0	07/23/90	25	1.4	7	0.28	0.123	25.0- 75.0	07/25/90	0.30	0.01
A1341	Q 13+41	15 U/S	5607.90	1	0.00	90.00	1- 1	0.0- 10.0	08/27/90	1.0- 10.0	08/28/90	2	0.01	7	0.00		1.0- 10.0	08/28/90	0.10	0.01
A1342	Q 13+42	15.0 U	5606.90	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	1.0- 10.0	07/23/90	2	3.5	7	0.70	9.763	1.0- 10.0	07/25/90	0.40	0.04

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1342	P 13+42.5	10.0 U	5607.95	2	321.00	90.00	1- 1	0.0- 5.5	05/10/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	05/14/90	-	/ /						5.5- 25.0	05/15/90	0.40	0.02
							2- 1	25.0- 75.0	05/18/90	25.0- 75.0	05/18/90	25	65	7	13.00	4.834	25.0- 75.0	05/22/90	1.50	0.03
A1345	P 13+45.0	15.0 U	5604.00	1	321.00	90.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/09/90	5.0- 29.0	04/10/90	9	3	7	0.60	0.908	15.0- 25.0	04/11/90	100.00	10.00
							- 2	-	/ /	-	/ /						5.5- 25.0	04/11/90	1.10	0.06
							2- 1	25.0- 75.0	04/24/90	25.0- 75.0	04/25/90	24	5.68	7	1.14	0.388	25.0- 75.0	04/26/90	64.20	1.28
A1347	Q 13+47	15.0 U	5603.00	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	1.0- 10.0	07/23/90	2	0.1	7	0.02	0.279	1.0- 10.0	07/25/90		
A1350	T 13+50.0	15.0 U	5602.00	1	321.00	90.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/18/90	5.5- 25.0	04/19/90	7	2.3	7	0.46	1.086	14.0- 25.0	04/23/90	0.30	0.03
							- 2	-	/ /	-	/ /						5.5- 25.0	04/23/90	7.70	0.39
							2- 1	25.0- 75.0	05/04/90	25.0- 75.0	05/07/90	27	1	7	0.20	0.106	25.0- 75.0	05/10/90	1.60	0.03
A1352	Q 13+52	15.0 U	5601.00	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	-	/ /						1.0- 10.0	07/25/90		
B1352	S 13+52.5	10.0 U	5601.00	2	321.00	90.00	1- 1	0.0- 5.5	05/10/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	05/15/90	5.5- 25.0	05/16/90	7	08	7	1.60	3.776	14.0- 25.0	05/16/90	1.30	0.12
							- 2	-	/ /	-	/ /						5.5- 25.0	05/16/90	1.10	0.06
							2- 1	25.0- 75.0	05/29/90	25.0- 75.0	05/29/90	25	45	7	9.00	3.527	25.0- 75.0	06/04/90	0.20	0.00
A1355	S 13+55.0	15.0 U	5600.00	1	321.00	90.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/12/90	5.5- 29.0	04/12/90	7	2.08	7	0.42	0.751	10.0- 25.0	04/18/90	3.80	0.25
							- 2	-	/ /	-	/ /						5.5- 25.0	04/18/90		
							2- 1	25.0- 75.0	04/30/90	25.0- 75.0	04/30/90	24	47	7	9.40	3.809	25.0- 75.0	05/02/90	30.20	0.60
A1357	Q 13+57	15.0 U	5599.00	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	1.0- 10.0	07/23/90	2	0.1	7	0.02	0.279	1.0- 10.0	07/25/90	0.10	0.01
C1357	P 13+57.5	12.5 U	5599.00	3	321.00	90.00	1- 1	0.0- 5.5	05/30/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	06/05/90	5.5- 25.0	06/05/90	6	0.01	7	0.00		-	/ /		
							2- 1	25.0- 75.0	06/08/90	25.0- 75.0	06/08/90	25	0.1	7	0.02	0.009	25.0- 75.0	06/12/90	0.40	0.01
							3- 1	75.0-150.0	06/14/90	75.0-150.0	06/15/90	47	03	7	0.60	0.097	75.0-150.0	06/18/90	0.40	0.01
A1360	T 13+60.0	15.0 U	5598.00	1	321.00	90.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/18/90	5.5- 25.0	04/19/90	7	2.45	7	0.49	1.096	14.0- 25.0	04/23/90	0.60	0.05

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1360	T 13+60.0	15.0	U 5598.00	1	321.00	90.00	1- 2	-	/ /	-	/ /						5.5- 25.0	04/23/90	0.40	0.02
							2- 1	25.0- 75.0	05/04/90	25.0- 75.0	05/07/90	27	6.1	7	1.22	0.675	25.0- 75.0	05/09/90	5.80	0.12
A1362	Q 13+62	15.0	U 5596.90	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	-	/ /						1.0- 10.0	07/25/90		
B1362	P 13+62.5	10.0	U 5596.90	2	321.00	90.00	1- 1	0.0- 5.5	05/10/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	05/14/90	-	/ /						13.0- 25.0	05/15/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 25.0	05/15/90	0.20	0.01
							2- 1	25.0- 75.0	05/17/90	25.0- 75.0	05/18/90	25	22	7	4.40	2.053	25.0- 75.0	05/22/90	0.60	0.01
A1365	P 13+65.0	15.0	U 5595.70	1	321.00	90.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/09/90	5.0- 29.0	04/10/90	9	7	7	1.40	2.256	15.0- 25.0	04/11/90	0.30	0.03
							- 2	-	/ /	-	/ /						5.5- 25.0	04/11/90	0.20	0.01
							2- 1	25.0- 75.0	04/24/90	25.0- 75.0	04/25/90	24	01	7	0.20	0.084	25.0- 75.0	04/26/90	0.90	0.02
A1367	Q 13+67	15.0	U 5594.60	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	1.0- 10.0	07/23/90	2	0.1	7	0.02	0.279	1.0- 10.0	07/25/90	0.10	0.01
A1370	T 13+70.0	15.0	U 5593.60	1	321.00	90.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/18/90	5.5- 25.0	04/19/90	7	29	7	5.80	15.271	14.0- 25.0	04/23/90	1.10	0.10
							- 2	-	/ /	-	/ /						5.5- 25.0	04/23/90	0.90	0.05
							2- 1	25.0- 75.0	05/04/90	25.0- 75.0	05/07/90	27	6	7	1.20	0.722	25.0- 75.0	05/09/90	27.60	0.55
A1372	Q 13+72	15.0	U 5592.50	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	-	/ /						1.0- 10.0	07/25/90	0.20	0.02
B1372	S 13+72.5	10.0	U 5592.50	2	321.00	87.00	1- 1	0.0- 5.5	05/10/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/15/90	5.5- 29.0	05/16/90	7	13	7	2.60	5.894	14.0- 29.0	05/16/90	1.30	0.09
							- 2	-	/ /	-	/ /						5.5- 29.0	05/16/90	0.20	0.01
							2- 1	29.0- 87.0	05/29/90	29.0- 87.0	05/29/90	25	1.6	7	0.32	0.121	29.0- 87.0	06/04/90	0.70	0.01
A1375	S 13+75.0	15.0	U 5591.40	1	321.00	89.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/12/90	5.5- 29.0	04/12/90	7	4.55	7	0.91	2.062	10.0- 25.0	04/17/90	49.50	3.30
							- 2	-	/ /	-	/ /						5.5- 25.0	04/17/90	1.10	0.06
							2- 1	25.0- 75.0	04/30/90	25.0- 75.0	04/30/90	24	0.93	7	0.19	0.084	25.0- 75.0	05/01/90	31.20	0.62
A1377	Q 13+77	15.0	U 5590.40	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	1.0- 10.0	07/23/90	2	0.1	7	0.02	0.279	1.0- 10.0	07/25/90		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1377	P 13+77.5	12.5 U	5590.40	3	321.00	85.00	1- 1	0.0- 5.5	05/30/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	06/05/90	5.5- 29.0	06/05/90	6	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	06/07/90	29.0- 87.0	06/08/90	29	1.3	7	0.26	0.102	29.0- 87.0	06/12/90	2.10	0.04
							3- 1	87.0-174.0	06/14/90	87.0-174.0	06/15/90	47	9.3	7	1.86	0.279	87.0-174.0	06/18/90	41.20	0.47
A1380	T 13+80.0	15.0 U	5589.30	1	321.00	87.00	1- 1	0.0- 5.5	04/06/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/18/90	5.5- 25.0	04/19/90	7	3.15	7	0.63	2.018	5.5- 25.0	04/23/90	2.00	0.10
							2- 1	25.0- 75.0	05/04/90	25.0- 75.0	05/07/90	34	2.7	7	0.54	0.257	25.0- 75.0	05/09/90	70.50	1.41
A1382	Q 13+82	15.0 U	5588.30	1	0.00	90.00	1- 1	0.0- 1.0	07/20/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	07/23/90	1.0- 10.0	07/23/90	2.0	0.1	7	0.02	0.298	1.0- 10.0	07/25/90	0.10	0.01
B1382	P 13+82.5	10.0 U	5588.30	2	321.00	84.00	1- 1	0.0- 5.5	05/10/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/14/90	5.5- 29.0	05/15/90	5	1.35	7	0.27	0.993	5.5- 29.0	05/15/90	0.60	0.03
							2- 1	29.0- 87.0	05/17/90	29.0- 87.0	05/18/90	25	2	7	0.40	0.191	29.0- 87.0	05/22/90	1.20	0.02
A1385	P 13+85.0	15.0 U	5587.20	1	321.00	85.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/09/90	5.0- 29.0	04/10/90	9	3	7	0.60	1.302	15.0- 29.0	04/10/90	75.80	5.41
							- 2	-	/ /	-	/ /						5.5- 25.0	04/11/90	21.60	1.11
							2- 1	25.0- 75.0	04/24/90	25.0- 75.0	04/25/90	24	1.97	7	0.39	0.185	25.0- 75.0	04/25/90	125.40	2.51
A1387	Q 13+87	15 U/S	5586.00	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	-	/ /						0.0- 10.0	09/07/90	0.40	0.04
							- 2	-	/ /	-	/ /						1.5- 10.0	09/07/90	1.60	0.19
A1390	T 13+90.0	15.0 U	5584.80	1	321.00	83.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/18/90	5.5- 25.0	04/19/90	7	4.6	7	0.92	3.761	10.0- 25.0	04/20/90	44.00	2.93
							- 2	-	/ /	-	/ /						5.5- 25.0	04/20/90	1.60	0.08
							2- 1	25.0- 45.0	05/04/90	25.0- 45.0	05/07/90	34	8.0	7	1.60	1.731	25.0- 75.0	05/08/90	43.40	0.87
							- 2	45.0- 75.0	05/10/90	-	/ /						45.0- 75.0	05/10/90	10.60	0.35
A1392	Q 13+92	15 U/S	5583.60	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	1.5- 10.0	09/07/90	3	01	7	0.20	2.987	0.0- 10.0	09/07/90	0.90	0.09
B1392	S 13+92.5	10.0 U	5583.60	2	321.00	81.00	1- 1	0.0- 5.5	05/10/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/15/90	5.5- 29.0	05/16/90	7	5	7	1.00	3.521	10.0- 29.0	05/16/90	0.70	0.04
							- 2	-	/ /	-	/ /						5.5- 29.0	05/16/90	0.30	0.01
							2- 1	29.0- 87.0	05/25/90	29.0- 87.0	05/29/90	2	6.2	7	1.24	10.152	29.0- 87.0	06/01/90	28.40	0.49
A1395	S 13+95.0	15.0 U	5582.50	1	321.00	81.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1395	S 13+95.0	15.0 U	5582.50	1	321.00	81.00	1- 2	5.5- 25.0	04/12/90	-	/ /						5.5- 25.0	04/16/90	16.60	0.85
							2- 1	25.0- 76.0	04/27/90	-	/ /						25.0- 76.0	05/01/90	35.10	0.69
A1397	Q 13+97	15 U/S	5581.30	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	1.5- 10.0	09/07/90	3	1.44	7	0.29	4.332	0.0- 10.0	09/07/90	0.30	0.03
C1397	P 13+97.5	12.5 U	5581.30	3	321.00	79.00	1- 1	0.0- 5.5	05/30/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	06/04/90	5.5- 29.0	06/05/90	6	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	06/07/90	29.0- 87.0	06/08/90	29	0.1	15	0.02	0.009	29.0- 87.0	06/12/90	12.70	0.22
							3- 1	87.0-174.0	06/13/90	-	/ /						87.0-174.0	06/15/90	54.40	0.63
A1400	T 14+00.0	15.0 U	5580.10	1	321.00	80.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 25.0	04/18/90	-	/ /						5.5- 25.0	04/20/90	26.40	1.35
							2- 1	29.0- 87.0	05/03/90	-	/ /						25.0- 76.0	05/08/90	91.50	1.79
A1402	Q 14+02	15 U/S	5587.90	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	1.5- 10.0	09/07/90	3	01	7	0.20	4.052	0.0- 10.0	09/07/90	1.80	0.18
B1402	P 14+02.5	10.0 U	5578.90	2	321.00	78.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/11/90	5.5- 29.0	05/11/90	7	5.3	7	1.06	4.324	5.5- 29.0	05/14/90	34.20	1.46
							2- 1	29.0- 87.0	05/17/90	29.0- 87.0	05/18/90	25	6	7	1.20	0.539	29.0- 87.0	05/21/90	44.00	0.76
A1405	P 14+05.0	15.0 U	5577.70	1	321.00	78.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	04/09/90	5.0- 29.0	04/10/90	7.5	1.9	7	0.38	1.113	15.0- 29.0	04/10/90	12.30	0.88
							- 2	-	/ /	-	/ /						5.5- 26.0	04/11/90	0.20	0.01
							2- 1	26.0- 77.0	04/24/90	26.0- 77.0	04/24/90	24	7.7	7	1.54	0.804	26.0- 77.0	04/25/90	105.60	2.07
A1407	Q 14+07	15 U/S	5577.80	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	-	/ /						0.0- 10.0	09/07/90	0.80	0.08
							- 2	-	/ /	-	/ /						1.5- 10.0	09/07/90	7.80	0.92
A1410	T 14+10.0	15.0 U	5578.00	1	321.00	76.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	04/18/90	5.5- 26.0	04/18/90	7	2.65	7	0.53	2.616	5.5- 26.0	04/20/90	6.10	0.30
							2- 1	26.0- 87.0	05/03/90	-	/ /						26.0- 77.0	05/08/90	33.30	0.65
A1412	Q 14+12	15 U/S	5578.10	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	1.5- 10.0	09/07/90	3	01	7	0.20	4.919	0.0- 10.0	09/07/90	0.30	0.03
B1412	S 14+12.5	10.0 U	5578.10	2	321.00	75.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/15/90	5.5- 29.0	05/16/90	7	2.7	7	0.54	2.388	8.0- 29.0	05/16/90	1.00	0.05

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1412	S 14+12.5	10.0 U	5578.10	2	321.00	75.00	1- 2	-	/ /	5.5- 29.0	05/16/90	7	3.7	7	0.74	3.272	5.5- 29.0	05/16/90	0.50	0.02
							2- 1	29.0- 87.0	05/25/90	29.0- 87.0	05/29/90	25	4.9	14	0.98	0.448	29.0- 87.0	06/04/90	27.90	0.48
A1415	S 14+15.0	15.0 U	5578.20	1	321.00	74.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 26.0	04/12/90	-	/ /						15.0- 26.0	04/16/90	28.70	2.61
							- 2	-	/ /	-	/ /						5.5- 26.0	04/16/90	1.80	0.09
							2- 1	26.0- 78.0	04/27/90	26.0- 78.0	04/30/90	24	2.51	7	0.50	0.262	26.0- 78.0	04/30/90	40.80	0.78
A1417	Q 14+17	15 U/S	5578.40	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	1.5- 10.0	09/07/90	3	01	7	0.20	4.919	0.0- 10.0	09/07/90	0.30	0.03
C1417	P 14+17.5	12.5 U	5578.40	3	321.00	77.00	1- 1	0.0- 5.5	05/30/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	06/04/90	5.5- 29.0	06/05/90	6	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	06/06/90	29.0- 87.0	06/08/90	28	0.1	7	0.02	0.008	29.0- 87.0	06/11/90	38.40	0.66
							3- 1	87.0-174.0	06/13/90	87.0-174.0	06/14/90	47	8.4	14	1.68	0.279	87.0-174.0	06/15/90	26.20	0.30
A1420	T 14+20.0	15.0 U	5578.50	1	321.00	72.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/18/90	-	/ /						13.0- 29.0	04/20/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	04/20/90	13.70	0.58
							2- 1	29.0- 87.0	05/03/90	-	/ /						29.0- 79.0	05/08/90	17.10	0.34
A1422	Q 14+22	15 U/S	5578.70	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	1.5- 10.0	09/07/90	3	05	7	1.00	17.195	0.0- 10.0	09/07/90	0.20	0.02
B1422	P 14+22.5	10.0 U	5578.75	2	321.00	72.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/11/90	5.5- 29.0	05/11/90	7	01	7	0.20	0.760	12.0- 29.0	05/14/90	0.90	0.05
							- 2	-	/ /	-	/ /						5.5- 29.0	05/14/90	21.30	0.91
							2- 1	29.0- 87.0	05/17/90	-	/ /						29.0- 87.0	05/22/90	9.60	0.17
A1425	P 14+25.0	15.0 U	5578.80	1	321.00	70.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/09/90	5.0- 29.0	04/10/90	7.5	01	7	0.20	0.557	15.0- 29.0	04/10/90	1.10	0.08
							- 2	-	/ /	-	/ /						5.5- 29.0	04/10/90	1.80	0.08
							2- 1	27.0- 80.0	04/23/90	-	/ /						27.0- 80.0	04/25/90	39.50	0.75
A1427	Q 14+27	15 U/S	5578.70	1	0.00	90.00	1- 1	0.0- 1.0	09/06/90	-	/ /						-	/ /		
							- 2	1.0- 10.0	09/07/90	-	/ /						0.0- 10.0	09/07/90	2.00	0.20
							- 2	-	/ /	-	/ /						1.5- 10.0	09/07/90	3.90	0.46
A1430	T 14+30.0	15.0 U	5578.70	1	321.00	68.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 27.0	04/18/90	5.5- 27.0	04/18/90	7	29	7	5.80	20.870	10.0- 27.0	04/20/90	0.40	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
A1430	T 14+30.0	15.0 U	5578.70	1	321.00	68.00	1- 2	-	/ /	-	/ /						5.5- 27.0	04/20/90	0.70	0.03
							2- 1	29.0- 87.0	05/03/90	27.0- 81.0	05/04/90	24	1.1	7	0.22	0.104	27.0- 81.0	05/08/90	37.30	0.69
							- 1	-	/ /	-	/ /						29.0- 87.0	05/08/90	8.30	0.14
							- 1	-	/ /	-	/ /						27.0- 81.0	05/08/90	0.90	0.02
B1432	S 14+32.5	10.0 U	5578.65	2	321.00	69.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/15/90	5.5- 29.0	05/16/90	6	01	7	0.20	0.788	13.0- 29.0	05/16/90	1.80	0.11
							- 2	-	/ /	-	/ /						5.5- 29.0	05/16/90	0.40	0.02
							2- 1	29.0- 87.0	05/25/90	-	/ /						29.0- 87.0	06/01/90	24.30	0.42
A1435	S 14+35.0	15.0 U	5578.60	1	321.00	66.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 27.0	04/11/90	5.5- 29.0	04/12/90	7	2.05	7	0.41	1.378	15.0- 27.0	04/16/90	32.00	2.67
							- 2	-	/ /	-	/ /						5.5- 27.0	04/16/90	0.20	0.01
							2- 1	27.0- 82.0	04/27/90	27.0- 82.0	04/27/90	24	3.5	7	0.70	0.326	27.0- 82.0	04/30/90	23.40	0.43
C1437	P 14+37.5	12.5 U	5578.55	3	321.00	67.00	1- 1	0.0- 5.5	05/30/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	06/04/90	5.5- 29.0	06/05/90	6	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	06/06/90	-	/ /						29.0- 87.0	06/11/90	21.10	0.36
							3- 1	87.0-174.0	06/13/90	87.0-174.0	06/14/90	47	4	21	0.80	0.128	87.0-174.0	06/15/90	148.50	1.71
A1440	T 14+40.0	15.0 U	5578.50	1	321.00	65.00	1- 1	0.0- 5.5	04/05/90	-	/ /						-	/ /		
							- 2	5.5- 28.0	04/18/90	5.5- 28.0	04/18/90	7	2	7	0.40	1.395	5.5- 28.0	04/19/90	7.10	0.32
							2- 1	29.0- 87.0	05/03/90	-	/ /						25.0- 75.0	05/07/90	15.30	0.31
B1442	P 14+42.5	10.0 U	5578.45	2	321.00	66.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/11/90	5.5- 29.0	05/11/90	7	85	7	17.00	57.136	5.5- 29.0	05/14/90	22.50	0.96
							2- 1	29.0- 87.0	05/17/90	-	/ /						29.0- 87.0	05/22/90	12.00	0.21
A1445	P 14+45.0	15.0 U	5578.40	1	321.00	60.00	1- 1	0.0- 5.5	04/04/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/09/90	5.0- 29.0	04/09/90	7.5	2.4	7	0.48	1.228	15.0- 29.0	04/10/90	12.30	0.88
							- 2	-	/ /	-	/ /						5.5- 29.0	04/10/90	10.20	0.43
							2- 1	29.0- 87.0	04/23/90	-	/ /						28.0- 84.0	04/25/90	20.00	0.36
A1450	T 14+50.0	15.0 U	5578.40	1	321.00	60.00	1- 1	0.0- 5.5	04/04/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/18/90	5.5- 29.0	04/18/90	7	3	7	0.60	2.042	13.0- 29.0	04/19/90	89.20	5.57
							- 2	-	/ /	-	/ /						5.5- 29.0	04/19/90	25.80	1.10
							2- 1	29.0- 87.0	05/02/90	29.0- 86.0	05/03/90	25	7.2	7	1.44	0.627	29.0- 87.0	05/07/90	9.00	0.16
B1452	S 14+52.5	10.0 U	5578.40	2	321.00	63.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/15/90	5.5- 29.0	05/16/90	8	2	7	0.40	1.173	13.0- 29.0	05/16/90	0.70	0.04

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
B1452	S 14+52.5	10.0	U 5578.40	2	321.00	63.00	1- 2	-	/ /	-	/ /						5.5- 29.0	05/16/90	0.20	0.01
							2- 1	29.0- 87.0	05/25/90	-	/ /						29.0- 87.0	06/01/90	4.50	0.08
A1455	S 14+55.0	15.0	U 5578.40	1	321.00	60.00	1- 1	0.0- 5.5	04/04/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/11/90	5.5- 29.0	04/12/90	7	95	7	19.00	64.667	5.5- 29.0	04/16/90	1.40	0.06
							2- 1	29.0- 87.0	04/27/90	29.0- 87.0	04/27/90	24	3.2	7	0.64	0.286	29.0- 87.0	04/30/90	12.80	0.22
C1457	P 14+57.5	12.5	U 5578.40	3	321.00	62.00	1- 1	0.0- 5.5	05/30/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	06/04/90	5.5- 29.0	06/05/90	6	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	06/06/90	29.0- 87.0	06/08/90	28	3.3	10	0.66	0.252	29.0- 87.0	06/08/90	2.60	0.04
							3- 1	87.0-174.0	06/12/90	-	/ /						87.0-174.0	06/14/90	28.40	0.33
A1460	T 14+60.0	15.0	U 5578.40	1	321.00	60.00	1- 1	0.0- 5.5	04/04/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/18/90	5.5- 29.0	04/18/90	7	07	7	1.40	4.765	13.0- 29.0	04/19/90	35.40	2.21
							- 2	-	/ /	-	/ /						5.5- 29.0	04/19/90	0.30	0.01
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	25	7.45	7	1.49	0.639	29.0- 87.0	05/07/90	44.40	0.77
B1462	P 14+62.5	10.0	U 5578.40	2	321.00	60.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/11/90	5.5- 29.0	05/11/90	7	47	7	9.40	31.993	5.5- 29.0	05/14/90	2.00	0.09
							2- 1	29.0- 87.0	05/17/90	29.0- 87.0	05/17/90	25	3.75	7	0.75	0.322	29.0- 87.0	05/18/90	15.40	0.27
A1465	P 14+65.0	15.0	U 5578.40	1	321.00	60.00	1- 1	0.0- 5.5	04/04/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/09/90	5.0- 29.0	04/09/90	7.5	6.1	7	1.22	3.122	15.0- 29.0	04/10/90	16.00	1.14
							- 2	-	/ /	-	/ /						5.5- 29.0	04/10/90	10.20	0.43
							2- 1	29.0- 87.0	04/23/90	29.0- 87.0	04/24/90	25	6.7	7	1.34	0.575	29.0- 87.0	04/24/90	0.80	0.01
A1470	T 14+70.0	15.0	U 5576.80	1	321.00	60.00	1- 1	0.0- 5.5	04/04/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/17/90	5.5- 29.0	04/18/90	9	3	7	0.60	1.562	5.5- 29.0	04/19/90	25.80	1.10
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	24	7.5	7	1.50	0.671	29.0- 87.0	05/07/90	43.20	0.74
B1472	S 14+72.5	10.0	U 5576.00	2	321.00	60.00	1- 1	0.0- 5.5	05/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/15/90	5.5- 29.0	05/16/90	8	5	7	1.00	2.950	5.5- 29.0	05/16/90	24.50	1.04
							2- 1	29.0- 87.0	05/24/90	-	/ /						29.0- 87.0	05/31/90	23.90	0.41
A1475	S 14+75.0	15.0	U 5575.20	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/11/90	-	/ /						2.5- 29.0	04/16/90	24.90	0.94
							2- 1	29.0- 87.0	04/26/90	-	/ /						29.0- 87.0	04/27/90	0.10	0.00
C1477	P 14+77.5	12.5	U 5574.40	3	321.00	60.00	1- 1	0.0- 2.5	05/30/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	06/04/90	2.5- 29.0	06/05/90	5	0.01	7	0.00		-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1477	P 14+77.5	12.5	U 5574.40	3	321.00	60.00	2- 1	29.0- 87.0	06/05/90	29.0- 87.0	06/08/90	38	2.1	10	0.53	0.145	29.0- 87.0	06/08/90	7.60	0.13
							3- 1	87.0-174.0	06/12/90	-	/ /						87.0-174.0	06/14/90	32.40	0.37
A1480	T 14+80.0	15.0	U 5573.60	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/17/90	2.5- 29.0	04/18/90	8	1.05	7	0.21	0.496	2.5- 29.0	04/18/90	0.70	0.03
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	32	5.65	7	1.13	0.377	29.0- 87.0	05/04/90	16.10	0.28
B1482	P 14+82.5	10.0	U 5572.80	2	321.00	60.00	1- 1	0.0- 2.5	05/09/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	05/11/90	2.5- 29.0	05/11/90	8	4.65	7	0.93	2.489	2.5- 29.0	05/14/90	23.40	0.88
							2- 1	29.0- 87.0	05/16/90	-	/ /						29.0- 87.0	05/18/90	52.30	0.90
A1485	P 14+85.0	15.0	U 5572.00	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/09/90	5.0- 29.0	04/09/90	7.5	2.8	7	0.56	1.433	5.0- 29.0	04/09/90	12.50	0.52
							- 2	-	/ /	-	/ /						2.5- 29.0	04/10/90	2.80	0.11
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/24/90	32	5.5	7	1.10	0.367	29.0- 87.0	04/24/90	1.60	0.03
A1490	T 14+90.0	15.0	U 5572.30	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/17/90	2.5- 29.0	04/18/90	8	4	7	0.80	1.889	2.5- 29.0	04/18/90	1.30	0.05
							2- 1	29.0- 87.0	05/01/90	29.0- 87.0	05/03/90	32	8.35	7	1.67	0.557	29.0- 87.0	05/04/90	35.80	0.62
B1492	S 14+92.5	10.0	U 5572.40	2	321.00	60.00	1- 1	0.0- 2.5	05/09/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	05/15/90	-	/ /						6.0- 29.0	05/15/90	2.10	0.09
							- 2	-	/ /	-	/ /						2.5- 29.0	05/15/90	2.40	0.09
							2- 1	29.0- 87.0	05/22/90	-	/ /						29.0- 87.0	05/31/90	22.80	0.39
A1495	S 14+95.0	15.0	U 5572.65	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/11/90	-	/ /						4.0- 29.0	04/12/90	25.70	1.03
							2- 1	29.0- 87.0	04/26/90	29.0- 87.0	04/27/90	28	4.1	7	0.82	0.313	29.0- 87.0	04/27/90	13.30	0.23
C1497	P 14+97.5	12.5	U 5572.80	3	321.00	60.00	1- 1	0.0- 2.5	05/30/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	06/04/90	2.5- 29.0	06/05/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	06/05/90	-	/ /						29.0- 87.0	06/11/90	15.90	0.27
							3- 1	87.0-174.0	06/12/90	87.0-174.0	06/13/90	47	3.35	14	0.67	0.108	87.0-174.0	06/14/90	43.80	0.50
A1500	T 15+00.0	15.0	U 5573.00	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/17/90	2.5- 29.0	04/18/90	8	45	7	9.00	20.351	2.5- 29.0	04/18/90	25.50	0.96
							2- 1	29.0- 87.0	05/01/90	-	/ /						29.0- 87.0	05/04/90	31.20	0.54
B1502	P 15+02.5	10.0	U 5573.15	2	321.00	60.00	1- 1	0.0- 2.5	05/08/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	05/11/90	2.5- 29.0	05/11/90	8	4	7	0.80	2.039	8.0- 29.0	05/14/90	0.60	0.03

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
B1502	P 15+02.5	10.0	U 5573.15	2	321.00	60.00	1- 2	-	/ /	-	/ /						2.5- 29.0	05/14/90	0.40	0.02
							2- 1	29.0- 87.0	05/16/90	29.0- 87.0	05/17/90	37	1.6	7	0.32	0.091	29.0- 87.0	05/18/90	3.50	0.06
A1505	P 15+05.0	15.0	U 5573.30	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/09/90	5.0- 29.0	04/09/90	7.5	3	7	0.60	1.470	5.0- 29.0	04/09/90	16.20	0.68
							- 2	-	/ /	-	/ /						2.5- 26.0	04/10/90	13.00	0.55
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/24/90	17	1.9	7	0.38	0.237	29.0- 87.0	04/24/90	128.50	2.22
A1510	T 15+10.0	15.0	U 5573.10	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/17/90	2.5- 29.0	04/18/90	8	45	7	9.00	20.351	13.0- 29.0	04/18/90	1.10	0.07
							- 2	-	/ /	-	/ /						2.5- 29.0	04/18/90	1.70	0.06
							2- 1	29.0- 87.0	05/01/90	-	/ /						29.0- 87.0	05/03/90	10.60	0.18
B1512	S 15+12.5	10.0	U 5573.00	2	321.00	60.00	1- 1	0.0- 2.5	05/08/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	05/15/90	-	/ /						2.5- 29.0	05/15/90	1.20	0.05
							2- 1	29.0- 87.0	05/22/90	-	/ /						29.0- 87.0	05/31/90	11.00	0.19
A1515	S 15+15.0	15.0	U 5572.90	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/11/90	-	/ /						5.0- 29.0	04/12/90	23.40	0.98
							2- 1	29.0- 87.0	04/26/90	-	/ /						29.0- 87.0	04/27/90	5.80	0.10
C1517	P 15+17.5	12.5	U 5572.80	3	321.00	60.00	1- 1	0.0- 2.5	04/07/93	-	/ /						-	/ /		
							- 2	2.5- 29.0	06/04/90	-	/ /						-	/ /		
							2- 1	29.0- 87.0	06/05/90	-	/ /						29.0- 87.0	06/08/90	17.00	0.29
							3- 1	87.0-174.0	06/11/90	-	/ /						87.0-174.0	06/14/90	46.30	0.53
A1520	T 15+20.0	15.0	U 5572.70	1	321.00	60.00	1- 1	0.0- 2.5	04/04/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	04/17/90	2.5- 29.0	04/18/90	8	05	7	1.00	2.261	12.0- 29.0	04/18/90	0.50	0.03
							- 2	-	/ /	-	/ /						2.5- 29.0	04/18/90	0.40	0.02
							2- 1	29.0- 87.0	05/01/90	-	/ /						29.0- 87.0	05/03/90	28.10	0.48
B1522	P 15+22.5	10.0	U 5572.60	2	321.00	60.00	1- 1	0.0- 2.0	11/03/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/10/89	-	/ /						5.0- 34.0	11/10/89	6.40	0.22
							- 2	-	/ /	-	/ /						2.0- 29.0	11/16/89	20.20	0.75
B1522	P 15+22.5	10.0	U 5572.60	2	321.00	60.00	2- 1	29.0- 87.0	11/14/89	29.0- 87.0	11/14/89	43	7	7	1.40	0.448	29.0- 87.0	11/15/89	1.10	0.02
A1525	P 15+25.0	15.0	U 5572.50	1	321.00	60.00	1- 1	0.0- 2.0	10/18/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/24/89	-	/ /						2.0- 29.0	10/24/89	14.30	0.53
							2- 1	29.0- 87.0	10/30/89	29.0- 87.0	10/31/89	25	7.4	7	1.48	1.046	29.0- 87.0	10/31/89	34.80	0.60

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1525	P 15+25.0	15.0 U	5572.50	1	321.00	60.00	2- 1	-	/ /	-	/ /						2.0- 88.0	10/31/89	4.70	0.05
A1530	T 15+30.0	15.0 U	5572.80	1	321.00	60.00	1- 1	0.0- 2.0	10/23/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/27/89	-	/ /						2.0- 31.0	10/27/89	4.20	0.14
							2- 1	29.0- 87.0	11/03/89	29.0- 87.0	11/06/89	38	8	7	1.60	0.469	29.0- 87.0	11/07/89	0.80	0.01
							- 1	-	/ /	-	/ /						2.0- 87.0	11/07/89	0.80	0.01
B1532	S 15+32.5	10.0 U	5572.90	2	321.00	60.00	1- 1	0.0- 2.0	11/03/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/11/89	-	/ /						10.0- 29.0	11/13/89	0.90	0.05
							- 2	-	/ /	-	/ /						2.0- 10.0	11/13/89	0.40	0.05
							2- 1	29.0- 87.0	11/17/89	29.0- 87.0	11/18/89	43	1.4	7	0.28	0.090	29.0- 87.0	11/18/89	3.80	0.07
							- 1	-	/ /	-	/ /						10.0- 29.0	11/18/89	0.60	0.03
A1535	S 15+35.0	15.0 U	5573.00	1	321.00	60.00	1- 1	0.0- 2.0	10/23/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	-	/ /						0.0- 29.0	10/25/89	12.10	0.42
							2- 1	29.0- 87.0	11/01/89	29.0- 87.0	11/02/89	38	7.2	7	1.44	0.422	29.0- 87.0	11/02/89	41.20	0.71
							- 1	-	/ /	-	/ /						2.0- 31.0	11/02/89	0.30	0.01
C1537	P 15+37.5	12.5 U	5573.15	3	321.00	60.00	1- 1	0.0- 2.5	11/20/89	-	/ /						-	/ /		
							- 2	2.5- 29.0	11/22/89	4.0- 29.0	11/22/89	5	01	15	0.20	1.403	-	/ /		
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/02/89	38	6.1	7	1.22	0.322	29.0- 87.0	12/04/89	1.00	0.02
							3- 1	87.0-174.0	12/19/89	87.0-174.0	12/20/89	61	21.1	15	4.22	0.608	87.0-174.0	12/20/89	102.10	1.17
A1540	T 15+40.0	15.0 U	5573.30	1	321.00	60.00	1- 1	0.0- 2.0	10/23/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/27/89	5.0- 29.0	10/27/89	7.5	1	7	0.20	0.490	2.0- 29.0	10/27/89	0.30	0.01
							- 2	-	/ /	-	/ /						2.0- 12.0	10/27/89	0.70	0.07
							2- 1	29.0- 87.0	11/03/89	29.0- 87.0	11/06/89	38	2.7	7	0.54	0.158	29.0- 87.0	11/07/89	7.70	0.13
							- 1	-	/ /	-	/ /						2.0- 87.0	11/07/89	0.20	0.00
B1542	P 15+42.5	10.0 U	5573.45	2	321.00	60.00	1- 1	0.0- 2.0	11/03/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/09/89	5.0- 29.0	11/10/89	7.5	1	7	0.20	0.490	5.0- 34.0	11/10/89	0.20	0.01
							2- 1	29.0- 87.0	11/14/89	29.0- 87.0	11/15/89	43	2.9	7	0.58	0.185	29.0- 87.0	11/15/89	2.90	0.05
							- 1	-	/ /	-	/ /						2.0- 29.0	11/15/89	1.10	0.04
A1545	P 15+45.0	15.0 U	5573.60	1	321.00	60.00	1- 1	0.0- 2.0	10/18/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/24/89	5.0- 29.0	10/24/89	7.5	1.3	7	0.26	0.637	10.0- 29.0	10/24/89	1.80	0.09
							- 2	-	/ /	-	/ /						0.0- 10.0	10/24/89	0.20	0.02
							2- 1	29.0- 87.0	10/31/89	29.0- 87.0	10/31/89	25	9.8	7	1.96	1.385	29.0- 86.0	10/31/89	56.60	0.99
							- 1	-	/ /	-	/ /						2.0- 88.0	10/31/89	3.40	0.04

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1547	S 15+47.5	12.5	U 5573.70	3	321.00	60.00	1- 1	0.0- 2.5	11/20/89	-	/ /						-	/ /		
							- 2	2.5- 29.0	11/30/89	2.0- 29.0	12/01/89	5	01	7	0.20	0.791	-	/ /		
							2- 1	29.0- 87.0	12/07/89	29.0- 87.0	12/08/89	38	7	7	1.40	0.545	-	/ /		
A1550	T 15+50.0	15.0	U 5573.80	1	321.00	60.00	1- 1	0.0- 2.0	10/23/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/27/89	7.5	1	7	0.20	0.344	2.0- 29.0	10/27/89	0.70	0.03
							2- 1	29.0- 87.0	11/04/89	29.0- 87.0	11/06/89	38	2.8	7	0.56	0.149	29.0- 87.0	11/07/89	4.70	0.08
							- 1	-	/ /	-	/ /						2.0- 87.0	11/07/89	0.60	0.01
B1552	S 15+52.5	10.0	U 5573.90	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	5.0- 29.0	11/13/89	7.5	3	7	0.60	1.033	10.0- 29.0	11/13/89	0.30	0.02
							- 2	-	/ /	-	/ /						2.0- 10.0	11/13/89	0.20	0.03
							2- 1	29.0- 87.0	11/17/89	29.0- 87.0	11/18/89	43	1.3	7	0.26	0.075	29.0- 87.0	11/19/89	2.50	0.04
							- 1	-	/ /	-	/ /						5.0- 29.0	11/19/89	1.10	0.05
A1555	S 15+55.0	15.0	U 5574.00	1	321.00	60.00	1- 1	0.0- 2.0	10/23/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	5.0- 29.0	10/25/89	7.5	1	7	0.20	0.344	10.0- 29.0	10/25/89	0.90	0.05
							- 2	-	/ /	-	/ /						0.0- 10.0	10/25/89	0.60	0.06
							2- 1	29.0- 87.0	11/01/89	29.0- 87.0	11/02/89	38	2.8	7	0.56	0.149	29.0- 87.0	11/02/89	10.10	0.17
							- 1	-	/ /	-	/ /						2.0- 31.0	11/02/89	3.20	0.11
C1557	P 15+57.5	12.5	U 5574.05	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/22/89	4.0- 29.0	11/22/89	5	01	7	0.20	1.403	-	/ /		
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/02/89	38	2.8	7	0.56	0.135	29.0- 87.0	12/04/89	1.80	0.03
							3- 1	87.0-174.0	12/19/89	87.0-174.0	12/20/89	81	30.5	10	6.10	0.603	87.0-174.0	12/20/89	130.10	1.50
A1560	T 15+60.0	15.0	U 5574.10	1	321.00	60.00	1- 1	0.0- 2.0	10/23/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/27/89	7.5	2	7	0.40	0.689	2.0- 29.0	10/27/89	0.20	0.01
							2- 1	29.0- 87.0	11/06/89	29.0- 87.0	11/06/89	38	1.5	7	0.30	0.080	29.0- 87.0	11/07/89	7.00	0.12
							- 1	-	/ /	-	/ /						2.0- 87.0	11/07/89	0.90	0.01
B1562	P 15+62.5	10.0	U 5574.20	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/09/89	5.0- 29.0	11/10/89	7.5	1	7	0.20	0.344	5.0- 34.0	11/10/89	0.40	0.01
							2- 1	29.0- 87.0	11/14/89	29.0- 87.0	11/15/89	43.0	13	7	2.60	0.746	29.0- 87.0	11/15/89	0.90	0.02
							- 1	-	/ /	-	/ /						2.0- 29.0	11/15/89	0.90	0.03
A1565	P 15+65.0	15.0	U 5574.30	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/18/89	5.0- 29.0	10/19/89	7.5	6	7	1.20	2.067	10.0- 29.0	10/19/89	0.40	0.02
							- 2	-	/ /	2.0- 29.0	10/19/89	3	1	7	0.20	0.518	0.0- 10.0	10/19/89	0.20	0.02
							2- 1	29.0- 87.0	10/30/89	29.0- 87.0	10/31/89	25.0	7.2	7	1.44	0.813	2.0- 89.0	10/31/89	7.60	0.09

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1567	S 15+67.5	12.5	U 5574.60	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/30/89	5.0- 29.0	12/01/89	7.5	01	7	0.20	0.622	-	/ /		
							2- 1	29.0- 87.0	12/07/89	29.0- 87.0	12/08/89	38	2	7	0.40	0.129	29.0- 87.0	12/08/89	4.80	0.08
A1570	T 15+70.0	15.0	U 5574.90	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/27/89	7.5	1	7	0.20	0.344	2.0- 29.0	10/27/89	0.20	0.01
							2- 1	29.0- 87.0	11/06/89	29.0- 87.0	11/06/89	38	4.4	7	0.88	0.233	29.0- 87.0	11/08/89	43.20	0.74
							- 1	-	/ /	-	/ /						2.0- 87.0	11/08/89	1.60	0.02
B1572	S 15+72.5	10.0	U 5574.75	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	5.0- 29.0	11/13/89	7.5	4	7	0.80	1.378	10.0- 29.0	11/13/89	1.10	0.06
							- 2	-	/ /	-	/ /						2.0- 10.0	11/13/89	0.70	0.09
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/18/89	43	2.1	7	0.42	0.121	29.0- 87.0	11/19/89	1.80	0.03
							- 1	-	/ /	-	/ /						2.0- 29.0	11/19/89	1.60	0.06
A1575	S 15+75.0	15.0	U 5574.60	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/20/89	10.0- 29.0	10/23/89	13.5	1.25	7	0.25	0.343	10.0- 29.0	10/23/89	0.70	0.04
							- 2	-	/ /	0.0- 29.0	10/23/89	13.5	4.0	7	0.80	2.417	0.0- 29.0	10/23/89	0.20	0.01
							2- 1	29.0- 87.0	11/01/89	29.0- 87.0	11/02/89	24	7.6	7	1.52	0.623	29.0- 87.0	11/02/89	5.40	0.09
							- 1	-	/ /	-	/ /						2.0- 29.0	11/02/89	5.00	0.19
C1577	P 15+77.5	12.5	U 5574.20	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/22/89	2.0- 29.0	11/22/89	5	01	7	0.20	1.318	-	/ /		
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/04/89	38	2.5	7	0.50	0.161	29.0- 87.0	12/04/89	1.20	0.02
							3- 1	87.0-174.0	12/15/89	87.0-174.0	12/20/89	113	10.6	7	2.12	0.185	87.0-174.0	12/20/89	5.20	0.06
A1580	T 15+80.0	15.0	U 5573.80	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	5.0- 29.0	10/25/89	7.5	6	7	1.20	2.067	2.0- 29.0	10/27/89	0.20	0.01
							2- 1	29.0- 87.0	11/06/89	29.0- 87.0	11/07/89	34	6.1	7	1.22	0.360	2.0- 87.0	11/08/89	2.40	0.03
B1582	P 15+82.5	10.0	U 5573.90	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/10/89	5.0- 29.0	11/10/89	7.5	5	7	1.00	1.722	5.0- 34.0	11/10/89	0.20	0.01
							2- 1	29.0- 87.0	11/15/89	29.0- 87.0	11/15/89	43	2.4	7	0.48	0.138	29.0- 87.0	11/16/89	3.40	0.06
							- 1	-	/ /	-	/ /						2.0- 29.0	11/16/89	0.30	0.01
D1583	P 15+83	13.0	U 5574.00	4	130.00	45.00	1- 2	0.0- 10.0	05/24/90	1.0- 10.0	05/30/90	3	01	7	0.20	2.561	1.0- 10.0	05/30/90	0.60	0.07
A1585	P 15+85.0	15.0	U 5574.00	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/18/89	2.0- 29.0	10/19/89	3	4	10	0.80	2.073	10.0- 29.0	10/19/89	4.80	0.25
							- 2	-	/ /	-	/ /						2.0- 29.0	10/19/89	0.40	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1585	P 15+85.0	15.0	U 5574.00	1	321.00	60.00	2- 1	29.0- 87.0	10/30/89	29.0- 87.0	10/31/89	38	01		0.20	0.053	2.0- 88.0	10/31/89	0.70	0.01
C1587	S 15+87.5	12.5	U 5574.50	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/01/89	5.0- 29.0	12/01/89	7.5	01	7	0.20	0.622	-	/ /		
							2- 1	29.0- 87.0	12/07/89	29.0- 87.0	12/08/89	38	1.06	7	0.21	0.068	29.0- 87.0	12/08/89	0.90	0.02
D1589	P 15+89	14.0	U 5575.00	4	115.00	45.00	1- 2	0.0- 10.0	05/24/90	1.0- 10.0	05/30/90	3	02	7	0.40	5.122	1.0- 10.0	05/30/90	0.80	0.09
A1590	T 15+90.0	15.0	U 5575.00	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	5.0- 29.0	10/25/89	7.5	5	7	1.00	1.722	2.0- 29.0	10/27/89	0.20	0.01
							2- 1	29.0- 87.0	11/06/89	2.0- 87.0	11/07/89	11	2.8	32	0.56	0.273	29.0- 87.0	11/09/89	0.80	0.01
							- 1	-	/ /	-	/ /						2.0- 31.0	11/09/89	0.20	0.01
B1592	S 15+92.5	10.0	U 5575.00	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	5.0- 29.0	11/13/89	7.5	01	7	0.20	0.344	10.0- 29.0	11/13/89	1.80	0.09
							- 2	-	/ /	-	/ /						2.0- 10.0	11/13/89	0.40	0.05
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/19/89	43	6.4	7	1.28	0.367	29.0- 87.0	11/19/89	1.50	0.03
							- 1	-	/ /	-	/ /						5.0- 29.0	11/19/89	0.40	0.02
A1595	S 15+95.0	15.0	U 5575.00	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/23/89	10.0- 29.0	10/23/89	13.5	7.35	7	1.47	2.940	10.0- 29.0	10/23/89	6.60	0.35
							- 2	-	/ /	-	/ /						0.0- 29.0	10/23/89	0.80	0.03
							2- 1	29.0- 87.0	11/02/89	29.0- 87.0	11/03/89	34	2.2	7	0.44	0.130	29.0- 87.0	11/03/89	10.70	0.18
							- 1	-	/ /	-	/ /						2.0- 31.0	11/03/89	0.20	0.01
C1597	P 15+97.5	12.5	U 5575.00	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/22/89	5.0- 29.0	11/22/89	5	2	7	0.40	1.008	10.0- 30.0	05/30/90	4.70	0.24
							- 2	-	/ /	5.0- 29.0	11/28/89	7.5	3	7	0.60	1.033	-	/ /		
							- 2	-	/ /	2.0- 30.0	05/30/90	33	5.4	7	1.08	0.566	-	/ /		
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/04/89	38	1.2	7	0.24	0.077	29.0- 87.0	12/06/89	2.20	0.04
							3- 1	87.0-174.0	12/18/89	87.0-174.0	12/20/89	113	15.6	7	3.12	0.272	87.0-174.0	12/21/89	5.80	0.07
D1600	P 16+00	20.0	U 5575.00	4	162.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/30/90	3	07	7	1.40	17.925	1.0- 10.0	05/30/90	0.80	0.09
A1600	T 16+00.0	15.0	U 5575.00	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	5.0- 29.0	10/25/89	7.5	3	7	0.60	1.033	2.0- 29.0	10/27/89	0.30	0.01
							2- 1	29.0- 87.0	11/07/89	29.0- 87.0	11/08/89	38	3.3	7	0.66	0.175	29.0- 87.0	11/09/89	11.60	0.20
							- 1	-	/ /	-	/ /						2.0- 31.0	11/09/89	0.40	0.01
B1602	P 16+02.5	10.0	U 5575.35	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1602	P 16+02.5	10.0	U 5575.35	2	321.00	60.00	1- 2	2.0- 29.0	11/10/89	5.0- 29.0	11/10/89	7.5	8	7	1.60	2.756	5.0- 34.0	11/10/89	0.20	0.01
							2- 1	29.0- 87.0	11/15/89	29.0- 87.0	11/15/89	43	8.9	7	1.78	0.511	29.0- 87.0	11/16/89	18.10	0.31
C1602	T 16+02.5	12.5	U 5575.35	3	321.00	60.00	1- 1	0.0- 1.5	12/08/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/12/89	5.0- 29.0	12/12/89	7.5	01	7	0.20	0.870	-	/ /		
							2- 1	29.0- 87.0	12/14/89	29.0- 87.0	12/14/89	30	2	7	0.40	0.164	29.0- 87.0	12/14/89	0.40	0.01
A1605	P 16+05.0	15.0	U 5575.70	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/18/89	-	/ /						2.0- 29.0	10/19/89	2.30	0.09
							- 2	-	/ /	-	/ /						2.0- 31.0	10/19/89	1.80	0.06
							2- 1	29.0- 87.0	10/31/89	29.0- 87.0	11/01/89	25	3	7	0.60	0.339	29.0- 87.0	11/01/89	28.50	0.49
							- 1	-	/ /	-	/ /						2.0- 31.0	11/01/89	2.80	0.10
C1607	S 16+07.5	12.5	U 5575.70	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/01/89	5.0- 29.0	12/01/89	7.5	01	7	0.20	0.622	-	/ /		
							2- 1	29.0- 87.0	12/08/89	-	/ /						29.0- 87.0	12/08/89	5.10	0.09
A1610	T 16+10.0	15.0	U 5575.70	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	-	/ /						2.0- 29.0	10/27/89	1.70	0.06
							2- 1	29.0- 87.0	11/07/89	29.0- 87.0	11/08/89	38	3.6	7	0.72	0.191	2.0- 87.0	11/09/89	3.20	0.04
D1612	P 16+12	15.0	U 5575.90	4	170.00	58.00	1- 2	0.0- 15.0	05/23/90	1.0- 15.0	05/30/90	3	01	7	0.20	1.355	1.0- 15.0	05/30/90	0.40	0.03
B1612	S 16+12.5	10.0	U 5576.00	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	5.0- 29.0	11/13/89	7.5	01	7	0.20	0.344	10.0- 29.0	11/13/89	0.90	0.05
							- 2	-	/ /	-	/ /						2.0- 10.0	11/13/89	1.80	0.23
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/19/89	43	4	7	0.80	0.230	29.0- 87.0	11/19/89	0.60	0.01
							- 1	-	/ /	-	/ /						5.0- 29.0	11/19/89	0.70	0.03
C1612	T 16+12.5	12.5	U 5576.00	3	321.00	60.00	1- 1	0.0- 1.5	12/08/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/12/89	5.0- 29.0	12/12/89	10	01	7	0.20	0.544	-	/ /		
							2- 1	29.0- 87.0	12/14/89	-	/ /						29.0- 87.0	12/14/89	0.60	0.01
A1615	S 16+15.0	15.0	U 5576.30	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/23/89	10.0- 29.0	10/23/89	13.5	0.8	7	0.16	0.220	10.0- 29.0	10/24/89	1.80	0.09
							- 2	-	/ /	-	/ /						0.0- 10.0	10/24/89	0.40	0.04
							- 2	-	/ /	-	/ /						2.0- 29.0	11/03/89	1.30	0.05
							2- 1	29.0- 87.0	11/02/89	29.0- 87.0	11/03/89	34	2.9	7	0.58	0.171	29.0- 87.0	11/03/89	10.10	0.17
C1617	P 16+17.5	12.5	U 5578.20	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1617	P 16+17.5	12.5	U 5578.20	3	321.00	60.00	1- 2	1.5- 29.0	11/22/89	1.5- 29.0	11/28/89	7.5	7	7	1.40	2.159	5.0- 29.0	12/01/89	0.30	0.01
							2- 1	29.0- 87.0	12/04/89	7.0- 87.0	12/04/89	15	1.8	7	0.36	0.155	29.0- 87.0	12/06/89	3.30	0.06
							3- 1	87.0-174.0	12/18/89	87.0-174.0	12/21/89	113	17.9	12	3.58	0.312	87.0-174.0	01/02/90	28.80	0.33
A1620	T 16+20.0	15.0	U 5580.10	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	5.0- 29.0	10/26/89	7.5	3	7	0.60	1.033	2.0- 31.0	10/30/89	1.10	0.04
							2- 1	29.0- 87.0	11/07/89	29.0- 87.0	11/09/89	38	3	7	0.60	0.159	2.0- 87.0	11/09/89	0.60	0.01
B1622	P 16+22.5	10.0	U 5580.30	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/11/89	3.0- 29.0	11/11/89	7	01	4	0.20	0.384	10.0- 39.0	11/11/89	1.80	0.06
							- 2	-	/ /	-	/ /						2.0- 12.0	11/11/89	0.70	0.07
							2- 1	29.0- 87.0	11/15/89	29.0- 87.0	11/16/89	43	4.1	7	0.82	0.235	29.0- 87.0	11/17/89	51.90	0.89
C1622	T 16+22.5	12.5	U 5580.30	3	321.00	60.00	1- 1	0.0- 1.5	12/08/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/12/89	5.0- 29.0	12/12/89	10	01	7	0.20	0.544	-	/ /		
							2- 1	29.0- 87.0	12/14/89	29.0- 87.0	12/14/89	30	1.4	7	0.28	0.115	29.0- 87.0	12/14/89	0.40	0.01
A1625	P 16+25.0	15.0	U 5580.50	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/18/89	-	/ /						10.0- 29.0	10/20/89	16.40	0.86
							- 2	-	/ /	-	/ /						2.0- 10.0	10/20/89	0.70	0.09
							- 2	-	/ /	-	/ /						10.0- 29.0	10/20/89	0.40	0.02
							2- 1	29.0- 87.0	10/31/89	29.0- 87.0	11/01/89	25	14.5	7	2.90	1.636	2.0- 89.0	11/01/89	1.10	0.01
C1627	S 16+27.5	12.5	U 5581.05	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/01/89	5.0- 29.0	12/01/89	7.5	01	7	0.20	0.622	-	/ /		
							2- 1	29.0- 87.0	12/08/89	29.0- 87.0	12/08/89	38	1.6	7	0.32	0.103	29.0- 87.0	12/11/89	12.80	0.22
A1630	T 16+30.0	15.0	U 5581.60	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/25/89	5.0- 29.0	10/26/89	7.5	2	7	0.40	0.689	2.0- 31.0	10/30/89	1.10	0.04
							2- 1	29.0- 87.0	11/09/89	29.0- 87.0	11/09/89	24	3.7	7	0.74	0.304	10.0- 87.0	11/09/89	9.40	0.12
B1632	S 16+32.5	10.0	U 5581.95	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	-	/ /						10.0- 29.0	11/14/89	1.10	0.06
							- 2	-	/ /	-	/ /						2.0- 10.0	11/14/89	0.40	0.05
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/19/89	43	8	7	1.60	0.459	29.0- 87.0	11/19/89	0.80	0.01
							- 1	-	/ /	-	/ /						10.0- 29.0	11/19/89	0.40	0.02
C1632	T 16+32.5	12.5	U 5581.95	3	321.00	60.00	1- 1	0.0- 1.5	12/12/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/13/89	5.0- 29.0	12/13/89	7.5	01	7	0.20	0.791	-	/ /		
							2- 1	29.0- 87.0	12/14/89	29.0- 87.0	12/14/89	30	7	7	1.40	0.574	29.0- 87.0	12/14/89	1.30	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1635	S 16+35.0	15.0	U 5582.30	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/23/89	10.0- 29.0	10/23/89	13.5	1.40	7	0.28	0.384	10.0- 29.0	10/24/89	1.70	0.09
							- 2	-	/ /	-	/ /						0.0- 10.0	10/24/89	0.90	0.09
							2- 1	29.0- 87.0	11/02/89	29.0- 87.0	11/03/89	34	2.7	7	0.54	0.159	29.0- 87.0	11/03/89	15.20	0.26
							- 1	-	/ /	-	/ /						0.0- 29.0	11/04/89	0.20	0.01
C1637	P 16+37.5	12.5	U 5582.90	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/22/89	1.5- 29.0	11/30/89	5	01	5	0.20	1.298	-	/ /		
							2- 1	29.0- 87.0	12/04/89	29.0- 87.0	12/04/89	38	2	7	0.40	0.129	29.0- 87.0	12/06/89	1.50	0.03
							3- 1	87.0-174.0	12/19/89	87.0-174.0	12/21/89	62	34.9	7	6.98	1.030	87.0-174.0	01/04/90	216.80	2.49
D1640	P 16+40	16.0	U 5582.50	4	182.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/30/90	3	16	7	3.20	40.972	1.0- 10.0	05/30/90	0.40	0.04
A1640	T 16+40.0	15.0	U 5583.50	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/26/89	7.5	1	7	0.20	0.344	2.0- 31.0	10/30/89	0.70	0.02
							2- 1	29.0- 87.0	11/08/89	29.0- 87.0	11/09/89	38	2.1	7	0.42	0.111	29.0- 87.0	11/10/89	4.00	0.07
							- 1	-	/ /	-	/ /						2.0- 29.0	11/10/89	1.10	0.04
B1642	P 16+42.5	10.0	U 5583.90	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/11/89	10.0- 29.0	11/11/89	14	6	7	1.20	2.154	10.0- 29.0	11/11/89	0.50	0.03
							- 2	-	/ /	-	/ /						2.0- 12.0	11/11/89	0.70	0.07
							2- 1	29.0- 87.0	11/15/89	29.0- 87.0	11/16/89	43	3.4	7	0.68	0.195	29.0- 87.0	11/17/89	1.20	0.02
							- 1	-	/ /	-	/ /						5.0- 29.0	11/17/89	1.30	0.05
C1642	T 16+42.5	12.5	U 5583.90	3	321.00	60.00	1- 2	0.0- 29.0	01/10/90	-	/ /						6.0- 30.0	01/11/90	24.40	1.02
							- 2	-	/ /	-	/ /						6.0- 29.0	03/10/93	8.00	0.35
A1645	P 16+45.0	15.0	U 5584.30	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/18/89	2.0- 29.0	10/19/89	3	5.4	7	1.08	2.799	3.0- 29.0	10/20/89	6.10	0.23
							2- 1	29.0- 87.0	10/31/89	29.0- 87.0	11/01/89	24	10.8	7	2.16	0.886	29.0- 87.0	11/01/89	2.10	0.04
							- 1	-	/ /	-	/ /						2.0- 31.0	11/01/89	3.40	0.12
C1647	S 16+47.5	12.5	U 5584.75	3	321.00	60.00	1- 1	0.0- 2.5	11/20/89	-	/ /						-	/ /		
							- 2	2.5- 29.0	12/01/89	5.0- 29.0	12/01/89	7.5	01	7	0.20	0.622	-	/ /		
							2- 1	29.0- 87.0	12/08/89	29.0- 87.0	12/08/89	38	6.2	7	1.24	0.399	29.0- 87.0	12/11/89	13.10	0.23
A1650	T 16+50.0	15.0	U 5585.20	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/26/89	7.5	5	7	1.00	1.722	2.0- 31.0	10/30/89	2.70	0.09
							2- 1	29.0- 87.0	11/08/89	29.0- 87.0	11/09/89	38	2.2	7	0.44	0.117	29.0- 87.0	11/10/89	1.00	0.02
							- 1	-	/ /	-	/ /						2.0- 29.0	11/10/89	0.20	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1652	S 16+52.5	10.0	U 5585.70	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	5.0- 29.0	11/13/89	7.5	1.4	7	0.28	0.482	10.0- 39.0	11/14/89	1.30	0.04
							- 2	-	/ /	-	/ /						2.0- 10.0	11/14/89	1.30	0.16
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/19/89	43	7.9	7	1.58	0.453	29.0- 87.0	11/20/89	2.10	0.04
							- 1	-	/ /	-	/ /						5.0- 29.0	11/20/89	0.60	0.03
A1655	S 16+55.0	15.0	U 5586.20	1	321.00	60.00	1- 1	0.0- 2.0	10/16/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/23/89	-	/ /						10.0- 29.0	10/24/89	4.20	0.22
							- 2	-	/ /	-	/ /						0.0- 10.0	10/24/89	3.40	0.34
							2- 1	29.0- 87.0	11/02/89	10.0- 87.0	11/03/89	19	1.6	7	0.32	0.128	29.0- 87.0	11/04/89	0.30	0.01
							- 1	-	/ /	-	/ /						0.0- 29.0	11/04/89	0.40	0.01
C1657	P 16+57.5	12.5	U 5586.55	3	321.00	60.00	1- 1	0.0- 1.5	11/20/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/22/89	5.0- 29.0	11/30/89	5	01	5	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/04/89	29.0- 87.0	12/06/89	38	1.4	7	0.28	0.090	29.0- 87.0	12/06/89	1.10	0.02
							3- 1	87.0-174.0	12/19/89	87.0-174.0	01/02/90	50.	40.0	7	8.00	1.677	87.0-174.0	01/04/90	55.10	0.63
A1660	T 16+60.0	15.0	U 5586.90	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/26/89	7.5	1	7	0.20	0.344	2.0- 31.0	10/30/89	0.40	0.01
							2- 1	29.0- 87.0	11/08/89	29.0- 87.0	11/09/89	14	2.1	12	0.42	0.282	29.0- 87.0	11/10/89	2.60	0.04
							- 1	-	/ /	-	/ /						5.0- 34.0	11/10/89	0.40	0.01
B1662	P 16+62.5	10.0	U 5586.80	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/11/89	10.0- 29.0	11/11/89	14	1.1	7	0.22	0.395	10.0- 29.0	11/11/89	0.20	0.01
							- 2	-	/ /	-	/ /						2.0- 10.0	11/11/89	1.30	0.16
							- 2	-	/ /	-	/ /						5.0- 29.0	11/18/89	0.20	0.01
							2- 1	29.0- 87.0	11/16/89	-	/ /						29.0- 87.0	11/17/89	11.30	0.19
A1665	P 16+65.0	15.0	U 5586.70	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/19/89	2.0- 29.0	10/19/89	3	2.2	7	0.44	1.140	10.0- 29.0	10/20/89	0.40	0.02
							- 2	-	/ /	-	/ /						2.0- 10.0	10/20/89	0.40	0.05
							2- 1	29.0- 87.0	10/31/89	29.0- 87.0	11/01/89	23	1.50	7	0.30	0.128	29.0- 87.0	11/01/89	3.20	0.06
							- 1	-	/ /	-	/ /						2.0- 31.0	11/01/89	1.10	0.04
C1667	S 16+67.5	12.5	U 5587.20	3	321.00	60.00	1- 1	0.0- 2.5	11/20/89	-	/ /						-	/ /		
							- 2	2.5- 29.0	12/01/89	5.0- 29.0	12/01/89	7.5	2	7	0.40	1.243	-	/ /		
							2- 1	29.0- 87.0	12/08/89	29.0- 87.0	12/08/89	25	2	7	0.40	0.204	29.0- 87.0	12/11/89	0.60	0.01
A1670	T 16+70.0	15.0	U 5587.70	1	321.00	60.00	1- 1	0.0- 2.0	10/17/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.0- 29.0	10/26/89	7.5	5	7	1.00	1.722	2.0- 31.0	10/30/89	0.60	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
A1670	T 16+70.0	15.0	U 5587.70	1	321.00	60.00	2- 1	29.0- 87.0	11/09/89	-	/ /						29.0- 87.0	11/10/89	2.50	0.04
							- 1	-	/ /	-	/ /						5.0- 29.0	11/10/89	0.20	0.01
B1672	S 16+72.5	10.0	U 5587.95	2	321.00	60.00	1- 1	0.0- 2.0	11/04/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/13/89	5.0- 29.0	11/14/89	7.5	7	7	1.40	2.411	10.0- 29.0	11/14/89	0.70	0.04
							- 2	-	/ /	-	/ /						2.0- 10.0	11/14/89	0.90	0.11
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/20/89	43	3.5	7	0.70	0.201	29.0- 87.0	11/20/89	0.70	0.01
							- 1	-	/ /	-	/ /						5.0- 29.0	11/20/89	1.10	0.05
A1675	S 16+75.0	15.0	U 5588.20	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	-	/ /						5.5- 29.0	10/16/89	3.40	0.14
							- 2	-	/ /	-	/ /						10.0- 29.0	10/24/89	31.90	1.68
							- 2	-	/ /	-	/ /						0.0- 10.0	10/24/89	2.00	0.20
							2- 1	29.0- 87.0	11/02/89	15.0- 87.0	11/03/89	25	9	7	1.80	0.847	29.0- 87.0	11/04/89	0.10	0.00
							- 1	-	/ /	-	/ /						0.0- 29.0	11/04/89	0.30	0.01
C1677	P 16+77.5	12.5	U 5588.25	3	321.00	60.00	1- 1	0.0- 2.5	11/20/89	-	/ /						-	/ /		
							- 2	2.5- 29.0	11/22/89	5.0- 29.0	11/30/89	5	01	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/04/89	29.0- 87.0	12/06/89	38	2.9	9	0.58	0.187	29.0- 87.0	12/06/89	1.10	0.02
							3- 1	87.0-174.0	12/18/89	87.0-174.0	01/03/90	32	16.7	7	3.34	0.974	87.0-174.0	01/08/90	56.30	0.65
A1680	T 16+80.0	15.0	U 5588.30	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/26/89	5.0- 29.0	10/26/89	7.5	1	7	0.20	0.344	2.0- 31.0	10/30/89	1.10	0.04
							2- 1	29.0- 87.0	11/09/89	29.0- 87.0	11/09/89	25	1	7	0.20	0.113	29.0- 87.0	11/10/89	1.60	0.03
							- 1	-	/ /	-	/ /						5.0- 29.0	11/10/89	0.40	0.02
B1682	P 16+82.5	10.0	U 5588.20	2	321.00	60.00	1- 1	0.0- 5.5	10/04/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/11/89	10.0- 29.0	11/11/89	14	01	7	0.20	0.359	10.0- 29.0	11/11/89	1.80	0.09
							- 2	-	/ /	-	/ /						2.0- 10.0	11/11/89	1.80	0.23
							- 2	-	/ /	-	/ /						2.0- 29.0	11/18/89	0.40	0.01
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/16/89	43	01	8	0.20	0.057	29.0- 87.0	11/18/89	0.90	0.02
A1685	P 16+85.0	15.0	U 5588.20	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/25/89	-	/ /						5.5- 29.0	09/26/89	3.00	0.13
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	1.90	0.07
							2- 1	29.0- 87.0	10/02/89	29.0- 86.6	10/03/89	25	8	18	1.60	0.908	29.0- 86.6	10/03/89	0.20	0.00
C1687	S 16+87.5	12.5	U 5588.15	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	12/12/89	29.0- 87.0	12/13/89	25	01	7	0.20	0.107	29.0- 87.0	12/14/89	0.60	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1690	T 16+90.0	15.0	U 5588.10	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	8.2	11	1.64	2.322	5.5- 29.0	10/16/89	6.90	0.29
							2- 1	29.0- 87.0	10/10/89	29.0- 87.0	10/11/89	17	7	5	1.40	1.385	29.0- 87.0	10/12/89	0.40	0.01
B1692	S 16+92.5	10.0	U 5588.25	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/13/89	5.0- 29.0	11/14/89	7.5	01	7	0.20	0.344	10.0- 29.0	11/14/89	1.00	0.05
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/20/89	43	1.1	7	0.22	0.063	29.0- 87.0	11/20/89	0.30	0.01
							- 1	-	/ /	-	/ /						2.0- 29.0	11/20/89	0.40	0.01
A1695	S 16+95.0	15.0	U 5588.40	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	4.5- 29.0	09/27/89	12	4	18	0.31	0.424	5.5- 29.0	10/16/89	0.90	0.04
							2- 1	29.0- 87.0	10/06/89	29.0- 87.0	10/09/89	17	8	5	1.60	1.582	29.0- 87.0	10/09/89	0.50	0.01
C1697	P 16+97.5	12.5	U 5588.23	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/27/89	5.0- 29.0	11/30/89	5	1	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/06/89	29.0- 87.0	12/06/89	25	1.4	7	0.28	0.150	10.0- 87.0	12/07/89	1.50	0.02
							3- 1	87.0-174.0	12/21/89	87.0-174.0	01/03/90	32	15	14	3.00	0.874	87.0-174.0	01/05/90	148.70	1.71
A1700	T 17+00.0	15.0	U 5588.05	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	1	10	0.20	0.269	5.5- 29.0	10/16/89	2.70	0.11
							2- 1	29.0- 87.0	10/10/89	29.0- 87.0	10/11/89	17	1	5	0.20	0.129	29.0- 87.0	10/12/89	0.80	0.01
B1702	P 17+02.5	10.0	U 5588.35	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/13/89	10.0- 29.0	11/11/89	14	01	5	0.20	0.322	10.0- 29.0	11/11/89	0.70	0.04
							- 2	-	/ /	-	/ /						2.0- 10.0	11/11/89	1.30	0.16
							- 2	-	/ /	-	/ /						5.0- 29.0	11/18/89	0.20	0.01
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/16/89	43	6.4	7	1.28	0.318	29.0- 87.0	11/18/89	2.70	0.05
A1705	P 17+05.0	15.0	U 5588.65	1	321.00	60.00	1- 1	0.0- 5.5	09/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/25/89	5.2- 29.0	09/25/89	12	36.7	15	7.34	11.150	15.0- 29.0	09/26/89	6.10	0.44
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	1.40	0.05
							2- 1	29.0- 87.0	10/02/89	29.0- 86.6	10/03/89	25	6.6	45	1.32	0.575	29.0- 86.6	10/03/89	11.20	0.19
C1707	S 17+07.5	12.5	U 5588.48	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	12/12/89	29.0- 87.0	12/13/89	25	01	7	0.20	0.083	29.0- 87.0	12/14/89	1.30	0.02
A1710	T 17+10.0	15.0	U 5588.30	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	4	11	0.80	1.075	5.5- 29.0	10/16/89	1.60	0.07
							2- 1	29.0- 87.0	10/10/89	29.0- 87.0	10/11/89	17	1.6	5	0.32	0.207	29.0- 87.0	10/12/89	1.50	0.03

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1712	S 17+12.5	10.0	U 5588.55	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/14/89	5.5- 29.0	11/14/89	5	35	7	7.00	16.349	10.0- 29.0	11/14/89	1.30	0.07
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/20/89	25	3	7	0.60	0.260	29.0- 87.0	11/20/89	0.20	0.00
							- 1	-	/ /	-	/ /						5.0- 29.0	11/20/89	0.20	0.01
A1715	S 17+15.0	15.0	U 5588.80	1	321.00	60.00	1- 1	0.0- 5.5	09/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	-	/ /						5.5- 29.0	10/16/89	8.50	0.36
							2- 1	29.0- 87.0	10/06/89	29.0- 87.0	10/09/89	17	7.9	5	1.58	1.022	29.0- 87.0	10/09/89	0.20	0.00
C1717	P 17+17.5	12.5	U 5588.60	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/27/89	5.0- 29.0	11/30/89	5	6	7	1.20	2.783	5.0- 29.0	12/01/89	0.40	0.02
							2- 1	29.0- 87.0	12/05/89	-	/ /						5.5- 89.0	12/07/89	0.20	0.00
							3- 1	87.0-174.0	12/21/89	87.0-174.0	01/04/90	29	14.2	7	2.84	0.751	87.0-174.0	01/05/90	5.90	0.07
A1720	T 17+20.0	15.0	U 5588.40	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	1	12	0.17	0.228	5.5- 29.0	10/16/89	2.60	0.11
							2- 1	29.0- 87.0	10/10/89	29.0- 87.0	10/11/89	17	4.3	5	0.86	0.556	29.0- 87.0	10/12/89	5.10	0.09
B1722	P 17+22.5	10.0	U 5588.55	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/13/89	5.5- 29.0	10/17/89	14	0	5	0.00		15.0- 29.0	10/17/89		
							- 2	-	/ /	-	/ /						5.5- 15.0	10/17/89	0.30	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	9.00	0.38
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/20/89	25.0	6	17	1.20	0.520	29.0- 87.0	10/23/89	0.40	0.01
							- 1	-	/ /	-	/ /						0.0- 29.0	10/23/89	1.10	0.04
A1725	P 17+25.0	15.0	U 5588.75	1	321.00	60.00	1- 1	0.0- 5.5	09/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/25/89	-	/ /						15.0- 29.0	09/26/89	1.80	0.13
							- 2	-	/ /	-	/ /						5.5- 29.0	10/04/89	2.30	0.10
							- 2	-	/ /	-	/ /						5.5- 34.5	10/04/89	3.40	0.12
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	0.70	0.02
							2- 1	29.0- 87.0	10/02/89	29.0- 86.6	10/03/89	25	12.8	7	2.56	1.116	29.0- 86.6	10/04/89	31.10	0.54
C1727	S 17+27.5	12.5	U 5588.63	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	12/12/89	29.0- 87.0	12/13/89	25	2	7	0.40	0.166	29.0- 87.0	12/14/89	0.50	0.01
A1730	T 17+30.0	15.0	U 5588.50	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	3	1	20	0.20	0.592	5.5- 29.0	10/16/89	1.80	0.08
							2- 1	29.0- 87.0	10/10/89	29.0- 87.0	10/12/89	25	4	5	0.80	0.347	29.0- 87.0	10/12/89	3.80	0.07

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1732	S 17+32.5	10.0	U 5588.55	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14.0	0.1	7	0.02	0.047	5.5- 15.0	10/19/89	0.20	0.02
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	2.80	0.12
							2- 1	29.0- 87.0	10/24/89	29.0- 87.0	10/24/89	25.0	0.1	7	0.02	0.009	29.0- 87.0	10/25/89	0.40	0.01
A1735	S 17+35.0	15.0	U 5588.60	1	321.00	60.00	1- 1	0.0- 5.5	09/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	5.6- 29.0	09/27/89	12	1.8	13	0.36	0.485	5.5- 29.0	10/16/89	2.00	0.09
							2- 1	29.0- 87.0	10/06/89	29.0- 87.0	10/09/89	17	0	5	0.00		29.0- 87.0	10/09/89	1.90	0.03
C1737	P 17+37.5	12.5	U 5588.55	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/27/89	5.0- 29.0	11/30/89	5	6	7	1.20	2.783	5.0- 29.0	12/01/89	0.90	0.04
							2- 1	29.0- 87.0	12/05/89	5.5- 89.0	12/07/89	25.	6.5	7	1.30	0.356	5.5- 89.0	12/07/89	28.10	0.34
							3- 1	87.0-174.0	01/02/90	87.0-174.0	01/04/90	27	14.5	7	2.90	0.825	87.0-174.0	01/05/90	36.20	0.42
C1740	Q 17+40	12.5	U 5588.50	3	321.00	60.00	1- 1	0.0- 5.5	12/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/19/89	-	/ /						-	/ /		
							2- 1	29.0- 87.0	12/19/89	29.0- 87.0	12/20/89	25	01	7	0.20	0.090	29.0- 87.0	12/21/89	2.30	0.04
A1740	T 17+40.0	15.0	U 5588.50	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/29/89	5	4	14	0.80	1.868	5.5- 29.0	10/16/89	2.70	0.11
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/12/89	25	5.8	5	1.16	0.503	29.0- 87.0	10/12/89	2.90	0.05
B1742	P 17+42.5	10.0	U 5588.70	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14	2	5	0.40	0.934	15.0- 29.0	10/17/89	0.80	0.06
							- 2	-	/ /	-	/ /						5.5- 15.0	10/17/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	1.20	0.05
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/20/89	25.0	1.5	7	0.30	0.130	29.0- 87.0	10/23/89	1.70	0.03
C1742	T 17+42.5	12.5	U 5588.70	3	321.00	60.00	1- 1	0.0- 5.5	12/14/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/15/89	5.5- 29.0	12/15/89	8	01	7	0.20	0.738	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/15/89	25	1	7	0.20	0.090	29.0- 87.0	12/15/89	48.70	0.84
C1745	Q 17+45	12.5	U 5588.90	3	321.00	60.00	1- 1	0.0- 5.5	12/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/20/89	-	/ /						-	/ /		
							2- 1	29.0- 87.0	12/20/89	29.0- 87.0	12/20/89	25	9	7	1.80	0.814	29.0- 87.0	12/21/89	0.20	0.00
A1745	P 17+45.0	15.0	U 5588.90	1	321.00	60.00	1- 1	0.0- 5.5	09/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/25/89	5.2- 29.0	09/25/89	12	13.2	16	2.64	3.522	15.0- 29.0	09/26/89	5.90	0.42
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	5.40	0.19
							2- 1	29.0- 87.0	10/02/89	29.0- 86.6	10/03/89	25	30	20	6.00	2.615	29.0- 86.6	10/04/89	13.00	0.23

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1747	S 17+47.5	12.5	U 5588.83	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 34.5	12/11/89	7	2	7	0.40	2.487	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/13/89	25	9	7	1.80	0.749	29.0- 87.0	12/14/89	2.20	0.04
C1750	Q 17+50	12.5	U 5588.75	3	321.00	60.00	1- 1	0.0- 5.5	12/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/19/89	-	/ /						-	/ /		
							2- 1	29.0- 87.0	12/19/89	29.0- 87.0	12/20/89	25	01	7	0.20	0.090	29.0- 87.0	12/21/89	1.60	0.03
A1750	T 17+50.0	15.0	U 5588.75	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/29/89	5	4	12	0.80	1.868	5.5- 29.0	10/16/89	1.70	0.07
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/12/89	25	2.6	5	0.52	0.225	29.0- 87.0	10/12/89	9.90	0.17
B1752	S 17+52.5	10.0	U 5588.70	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14.0	0.1	7	0.02	0.047	15.0- 44.0	10/19/89	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	1.40	0.06
							2- 1	29.0- 87.0	10/24/89	29.0- 87.0	10/24/89	25.0	0.1	7	0.02	0.009	29.0- 87.0	10/25/89	0.60	0.01
C1752	T 17+52.5	12.5	U 5588.68	3	321.00	60.00	1- 1	0.0- 5.5	12/14/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/15/89	5.5- 29.0	12/15/89	7	1	7	0.20	0.885	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/15/89	25	01	7	0.20	0.090	29.0- 87.0	12/15/89	8.30	0.14
C1755	Q 17+55	12.5	U 5588.60	3	321.00	60.00	1- 1	0.0- 5.5	12/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/20/89	-	/ /						-	/ /		
							2- 1	29.0- 87.0	12/20/89	29.0- 87.0	12/20/89	25	01	7	0.20	0.090	29.0- 87.0	12/21/89	0.70	0.01
A1755	S 17+55.0	15.0	U 5588.60	1	321.00	60.00	1- 1	0.0- 5.5	09/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	5.4- 29.0	09/28/89	12	2.1	11	0.42	0.563	5.5- 29.0	10/16/89	1.90	0.08
							2- 1	29.0- 87.0	10/06/89	29.0- 87.0	10/09/89	17	12.1	5	2.42	1.565	29.0- 87.0	10/09/89	1.20	0.02
C1757	P 17+57.5	12.5	U 5588.68	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/27/89	5.0- 29.0	11/30/89	5	3	7	0.60	4.351	-	/ /		
							2- 1	29.0- 87.0	12/05/89	5.5- 89.0	12/07/89	25.	2.0	7	0.40	0.099	5.5- 89.0	12/07/89	1.50	0.02
							3- 1	87.0-174.0	01/03/90	87.0-174.0	01/05/90	28.0	13.0	7	2.60	0.740	87.0-174.0	01/08/90	14.80	0.17
A1760	T 17+60.0	15.0	U 5588.75	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/29/89	5	5	11	1.00	2.336	5.5- 29.0	10/16/89	2.30	0.10
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/12/89	58	13.8	5	2.76	1.196	29.0- 87.0	10/12/89	0.40	0.01
B1762	P 17+62.5	10.0	U 5588.70	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
B1762	P 17+62.5	10.0	U 5588.70	2	321.00	60.00	1- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14	0	5	0.00		15.0- 29.0	10/17/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 14.9	10/17/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	0.90	0.04
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/20/89	25.0	1.6	7	0.32	0.139	29.0- 87.0	10/23/89	3.60	0.06
A1765	P 17+65.0	15.0	U 5588.70	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.4- 29.0	09/25/89	12	7.7	12	1.54	2.064	5.5- 29.0	09/26/89	3.00	0.13
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	5.10	0.18
							2- 1	29.0- 87.0	10/03/89	29.0- 86.6	10/03/89	25	23.7	21	4.74	2.066	29.0- 86.6	10/04/89	1.70	0.03
C1767	S 17+67.5	12.5	U 5588.88	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/13/89	25	1.5	7	0.30	0.125	29.0- 87.0	12/14/89	0.50	0.01
A1770	T 17+70.0	15.0	U 5589.05	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/29/89	5	1	11	0.20	0.467	5.5- 29.0	10/16/89	1.50	0.06
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/12/89	25	13.6	5	2.72	1.179	29.0- 87.0	10/12/89	0.30	0.01
B1772	S 17+72.5	10.0	U 5589.10	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14.0	0.3	7	0.06	0.140	15.0- 44.0	10/19/89	0.80	0.03
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	1.60	0.07
							2- 1	29.0- 87.0	10/24/89	29.0- 87.0	10/25/89	25.0	0.5	7	0.10	0.043	29.0- 87.0	10/26/89	0.60	0.01
C1772	T 17+72.5	12.5	U 5589.13	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/17/90	5.0- 29.0	01/17/90	7	1	7	0.20	0.870	-	/ /		
A1775	S 17+75.0	15.0	U 5589.20	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.2- 29.0	09/28/89	12	5.5	12	1.10	1.467	5.5- 29.0	10/16/89	2.80	0.12
							2- 1	29.0- 87.0	10/09/89	29.0- 87.0	10/09/89	17	0	5	0.00		29.0- 87.0	10/10/89	29.10	0.50
C1777	P 17+77.5	12.5	U 5589.10	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	5	2	7	0.40	2.900	-	/ /		
							2- 1	29.0- 87.0	12/06/89	5.5- 89.0	12/07/89	25.	10.2	7	2.04	0.625	5.5- 89.0	12/07/89	5.00	0.06
							3- 1	87.0-174.0	01/03/90	87.0-174.0	01/05/90	28.0	20.7	14	4.14	1.178	87.0-174.0	01/08/90	100.40	1.15
A1780	T 17+80.0	15.0	U 5589.00	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	1.7	10	0.34	0.794	5.5- 29.0	10/16/89	3.00	0.13
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/13/89	25	2.7	33	0.54	0.234	29.0- 87.0	10/13/89	2.20	0.04

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1782	P 17+82.5	10.0 U	5589.05	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14	2	5	0.40	0.934	15.0- 29.0	10/17/89	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 15.0	10/17/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	1.40	0.06
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/20/89	25.0	9	7	1.80	0.780	29.0- 87.0	10/23/89	0.30	0.01
C1782	T 17+82.5	12.5 U	5589.05	3	321.00	60.00	1- 2	0.0- 29.0	01/17/90	5.0- 29.0	01/17/90	7	01	7	0.20	0.870	-	/ /		
A1785	P 17+85.0	15.0 U	5589.10	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.4- 29.0	09/25/89	12	12	12	2.40	3.224	5.5- 29.0	09/27/89	1.70	0.07
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	1.70	0.06
							2- 1	29.0- 87.0	10/02/89	29.0- 86.6	10/03/89	25	1	5	0.20	0.087	29.0- 86.6	10/05/89	105.00	1.82
C1787	S 17+87.5	12.5 U	5589.03	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/17/90	5.5- 29.0	12/11/89	7	1	7	0.20	1.475	-	/ /		
							- 2	-	/ /	5.0- 29.0	01/17/90	7	01	7	0.20	0.870	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/13/89	25	6.9	7	1.38	0.574	29.0- 87.0	12/14/89	1.60	0.03
A1790	T 17+90.0	15.0 U	5588.95	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	2.3	11	0.46	1.074	5.5- 29.0	10/16/89	2.70	0.11
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/13/89	25	3	5	0.60	0.260	29.0- 87.0	10/13/89	0.10	0.00
B1792	S 17+92.5	10.0 U	5589.00	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14.0	0.1	7	0.02	0.047	15.0- 44.0	10/19/89	1.10	0.04
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	1.10	0.07
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	1.70	0.07
							2- 1	29.0- 87.0	10/24/89	29.0- 87.0	10/25/89	25.0	0.6	7	0.12	0.052	29.0- 87.0	10/26/89	0.30	0.01
A1795	S 17+95.0	15.0 U	5589.10	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	6.6	13	1.10	1.477	5.5- 29.0	10/16/89	2.40	0.10
							2- 1	29.0- 87.0	10/09/89	29.0- 87.0	10/09/89	17	6.5	5	1.30	0.841	29.0- 87.0	10/10/89	9.30	0.16
C1797	P 17+97.5	12.5 U	5589.03	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	5	1	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/06/89	5.5- 89.0	12/07/89	25.	1.0	7	0.20	0.055	29.0- 87.0	12/07/89	1.00	0.02
							3- 1	87.0-174.0	01/02/90	87.0-174.0	01/05/90	33.0	25.9	7	5.18	1.238	87.0-174.0	01/09/90	192.70	2.21
A1800	T 18+00.0	15.0 U	5588.95	1	321.00	60.00	1- 1	0.0- 5.5	09/22/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	9	10	1.80	4.204	5.5- 29.0	10/16/89	1.60	0.07
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/13/89	25	5.6	7	1.12	0.355	29.0- 87.0	10/13/89	16.80	0.29

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1802	P 18+02.5	10.0	U 5588.90	2	321.00	60.00	1- 1	0.0- 5.5	10/05/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14	4	5	0.80	1.868	15.0- 29.0	10/17/89	6.20	0.44
							- 2	-	/ /	-	/ /						5.5- 15.0	10/17/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	5.10	0.22
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/20/89	25.0	1.4	7	0.28	0.089	29.0- 87.0	10/23/89	0.40	0.01
C1802	T 18+02.5	12.5	U 5588.98	3	321.00	60.00	1- 1	0.0- 5.5	12/14/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/15/89	5.5- 29.0	12/15/89	7	01	7	0.20	0.885	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/18/89	25	2	7	0.40	0.131	29.0- 87.0	12/18/89	2.00	0.03
A1805	P 18+05.0	15.0	U 5589.00	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.4- 29.0	09/25/89	12	1.7	9	0.34	0.456	5.5- 29.0	09/27/89	2.00	0.09
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	2.00	0.07
							2- 1	29.0- 87.0	10/03/89	29.0- 86.6	10/03/89	25	37	5	7.40	2.359	29.0- 87.0	10/05/89	105.00	1.81
C1807	S 18+07.5	12.5	U 5589.15	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7	3	7	0.60	1.401	5.5- 29.0	12/12/89	0.20	0.01
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/13/89	25	8.5	7	1.70	0.523	29.0- 87.0	12/14/89	2.90	0.05
A1810	T 18+10.0	15.0	U 5589.30	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	2	7	1.00	2.336	5.5- 29.0	10/16/89	1.30	0.06
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/13/89	25	4.8	5	0.96	0.304	29.0- 87.0	10/13/89		
B1812	S 18+12.5	10.0	U 5587.50	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14.0	1.1	7	0.22	0.514	15.0- 44.0	10/19/89	1.20	0.04
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	1.10	0.07
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	2.30	0.10
							2- 1	29.0- 87.0	10/25/89	29.0- 87.0	10/25/89	25.0	0.7	7	0.14	0.044	29.0- 87.0	10/26/89	0.30	0.01
C1812	T 18+12.5	12.5	U 5587.58	3	321.00	60.00	1- 1	0.0- 5.5	12/14/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/15/89	5.5- 29.0	12/15/89	7	1	7	0.20	0.885	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/18/89	25	01	7	0.20	0.065	29.0- 87.0	12/18/89	0.40	0.01
A1815	S 18+15.0	15.0	U 5585.85	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	5.7- 29.0	09/27/89	12	8.4	19	1.68	2.267	5.5- 29.0	10/16/89	3.30	0.14
							2- 1	29.0- 87.0	10/09/89	29.0- 87.0	10/09/89	17	0	5	0.00		29.0- 87.0	10/11/89	15.90	0.27
C1817	P 18+17.5	12.5	U 5587.88	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	5	4	7	0.80	5.801	-	/ /		
							2- 1	29.0- 87.0	12/06/89	-	/ /						5.5- 89.0	12/07/89	1.20	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
C1817	P 18+17.5	12.5 U	5587.88	3	321.00	60.00	3- 1	87.0-174.0	12/21/89	87.0-174.0	01/05/90	33.0	19.4	7	3.88	0.653	87.0-174.0	01/10/90	356.00	4.09
A1820	T 18+20.0	15.0 U	5589.90	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	7.7	16	0.86	2.009	5.5- 29.0	10/16/89	4.00	0.17
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/13/89	25	2.7	7	0.54	0.171	29.0- 87.0	10/13/89	3.10	0.05
B1822	P 18+22.5	10.0 U	5587.85	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14	6	7	1.20	2.803	15.0- 29.0	10/17/89	1.50	0.11
							- 2	-	/ /	-	/ /						5.5- 15.0	10/17/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	2.30	0.10
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/20/89	25.0	1.5	7	0.30	0.095	29.0- 87.0	10/23/89	0.80	0.01
A1825	P 18+25.0	15.0 U	5589.80	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.8- 29.0	09/25/89	12	4	11	0.80	1.082	5.5- 29.0	09/26/89	1.40	0.06
							- 2	-	/ /	-	/ /						0.0- 29.0	10/05/89	2.30	0.08
							2- 1	29.0- 87.0	10/03/89	29.0- 86.6	10/03/89	25	44	5	8.80	2.805	29.0- 86.6	10/05/89	79.80	1.39
A1830	T 18+30.0	15.0 U	5590.90	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	1	15	0.20	0.467	5.5- 29.0	10/16/89	2.20	0.09
							2- 1	29.0- 87.0	10/12/89	-	/ /						29.0- 87.0	10/13/89	1.80	0.03
B1832	S 18+32.5	10.0 U	5590.70	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14.0	2.6	7	0.52	1.215	15.0- 44.0	10/19/89	0.70	0.02
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	0.70	0.05
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	3.80	0.16
							2- 1	29.0- 87.0	10/25/89	29.0- 87.0	10/26/89	25.0	0.9	7	0.18	0.057	29.0- 87.0	10/26/89	0.20	0.00
A1835	S 18+35.0	15.0 U	5590.50	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	5.6- 29.0	09/27/89	12	13.5	11	2.70	3.635	5.5- 29.0	10/16/89	2.50	0.11
							2- 1	29.0- 87.0	10/09/89	29.0- 87.0	10/09/89	17	0	5	0.00		29.0- 87.0	10/11/89	0.20	0.00
C1837	P 18+37.5	12.5 U	5591.15	3	321.00	60.00	1- 1	0.0- 5.5	11/20/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	5	1	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/07/89	29.0- 87.0	12/07/89	25	4	7	0.80	0.226	29.0- 87.0	12/08/89	2.10	0.04
							3- 1	87.0-174.0	12/20/89	87.0-174.0	01/05/90	33.0	18.3	7	3.66	0.616	87.0-174.0	01/10/90	77.60	0.89
A1840	T 18+40.0	15.0 U	5591.80	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	4.4	10	0.88	2.055	5.5- 29.0	10/16/89	1.80	0.08
							2- 1	29.0- 87.0	10/13/89	29.0- 87.0	10/13/89	25	5.4	7	1.08	0.342	29.0- 87.0	10/16/89	1.80	0.03

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1842	P 18+42.5	10.0 U	5591.90	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/16/89	-	/ /						15.0- 29.0	10/17/89	1.50	0.11
							- 2	-	/ /	-	/ /						5.5- 15.0	10/17/89	0.20	0.02
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	2.60	0.11
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/23/89	25.0	0	10	0.00		29.0- 87.0	10/23/89	0.80	0.01
A1845	P 18+45.0	15.0 U	5592.00	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.2- 29.0	09/25/89	12	4.8	18	0.96	1.281	5.5- 29.0	09/26/89	0.70	0.03
							- 2	-	/ /	-	/ /						0.0- 29.0	10/09/89	1.00	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	10/16/89	3.40	0.14
							2- 1	29.0- 87.0	10/03/89	29.0- 86.6	10/04/89	25	29		5.80	1.849	29.0- 86.6	10/06/89	27.20	0.47
C1847	S 18+47.5	12.5 U	5592.10	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/17/90	5.5- 29.0	01/18/90	4.0	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	01/18/90	29.0- 87.0	01/22/90	25.0	1.3	7	0.26	0.080	29.0- 87.0	01/22/90	1.10	0.02
							3- 1	87.0-174.0	01/23/90	87.0-174.0	01/25/90	53.0	37.1	20	3.71	0.510	87.0-174.0	01/26/90	223.90	2.57
A1850	T 18+50.0	15.0 U	5592.20	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	4	13	0.80	1.868	5.5- 29.0	10/16/89	4.40	0.19
							2- 1	29.0- 87.0	10/13/89	29.0- 87.0	10/13/89	25	6.5	7	1.30	0.412	29.0- 87.0	10/16/89	2.90	0.05
B1852	S 18+52.5	10.0 U	5592.50	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/18/89	14	1	7	0.20	0.467	15.0- 44.0	10/19/89	0.20	0.01
							- 2	-	/ /	5.5- 29.0	10/19/89	14.0	0.2	7	0.04	0.093	5.5- 20.5	10/19/89	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	3.70	0.16
							2- 1	29.0- 87.0	10/25/89	29.0- 87.0	10/26/89	25.0	0.4	7	0.08	0.025	29.0- 87.0	10/27/89	1.10	0.02
A1855	S 18+55.0	15.0 U	5592.80	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/27/89	5.5- 29.0	09/28/89	12	7	11	1.40	1.880	5.5- 29.0	10/16/89	1.70	0.07
							2- 1	29.0- 87.0	10/09/89	29.0- 87.0	10/09/89	17	18.0	5	3.60	1.502	29.0- 87.0	10/11/89	25.10	0.43
C1857	P 18+57.5	12.5 U	5592.90	3	321.00	60.00	1- 1	0.0- 5.5	11/21/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	5	01	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/07/89	29.0- 87.0	12/07/89	25	7.5	7	1.50	0.424	29.0- 87.0	12/08/89	2.00	0.03
							3- 1	87.0-174.0	12/21/89	87.0-174.0	01/08/90	43.0	27.7	10	5.54	0.932	87.0-174.0	01/11/90	10.50	0.12
							- 1	-	/ /	-	/ /						5.0-174.0	01/11/90	22.00	0.13
A1860	T 18+60.0	15.0 U	5593.00	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	1	13	0.20	0.467	5.5- 29.0	10/16/89	3.10	0.13
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/16/89	25	60	7	12.00	3.799	29.0- 87.0	10/16/89	0.40	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
B1862	P 18+62.5	10.0	U 5593.50	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14.0		12	0.00		15.0- 29.0	10/18/89	1.80	0.13
							- 2	-	/ /	-	/ /						5.5- 15.0	10/18/89	0.20	0.02
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	1.00	0.04
							2- 1	29.0- 87.0	10/20/89	29.0- 87.0	10/23/89	25.0	0	7	0.00		29.0- 87.0	10/23/89	29.00	0.50
A1865	P 18+65.0	15.0	U 5594.00	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.4- 29.0	09/25/89	12	10.9	15	2.18	2.921	5.5- 29.0	09/27/89	3.00	0.13
							- 2	-	/ /	-	/ /						0.0- 29.0	10/09/89	1.00	0.03
							2- 1	29.0- 87.0	10/04/89	29.0- 86.6	10/04/89	17	20.5	8	4.10	1.722	29.0- 86.6	10/06/89	51.40	0.89
C1867	S 18+67.5	12.5	U 5595.30	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/17/90	5.5- 29.0	01/18/90	4.0	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	01/19/90	29.0- 87.0	01/22/90	25.0	1.8	7	0.36	0.111	29.0- 87.0	01/22/90	3.20	0.06
							3- 1	87.0-174.0	01/23/90	87.0-174.0	01/25/90	53.0	42.2	20	4.22	0.580	87.0-174.0	01/26/90	0.20	0.00
A1870	T 18+70.0	15.0	U 5596.60	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	3	11	0.60	1.401	5.5- 29.0	10/02/89	1.30	0.06
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/16/89	25	8.2	12	1.64	0.519	29.0- 87.0	10/16/89	2.50	0.04
B1872	S 18+72.5	10.0	U 5596.00	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/18/89	5.5- 29.0	10/19/89	14.0	0.4	7	0.08	0.187	15.0- 44.0	10/19/89	1.10	0.04
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	1.10	0.07
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	4.40	0.19
							2- 1	29.0- 87.0	10/26/89	29.0- 87.0	10/27/89	25.0	0.4	7	0.08	0.025	29.0- 87.0	10/27/89	1.10	0.02
A1875	S 18+75.0	15.0	U 5595.40	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	2.6	11	0.52	0.698	5.5- 29.0	10/16/89	2.20	0.09
							2- 1	29.0- 87.0	10/10/89	29.0- 87.0	10/10/89	25	4.5	5	0.90	0.285	29.0- 87.0	10/11/89	1.70	0.03
C1877	P 18+77.5	12.5	U 5595.55	3	321.00	60.00	1- 1	0.0- 5.5	11/21/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	5	01	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	12/07/89	-	/ /						29.0- 87.0	12/08/89	1.00	0.02
							3- 1	87.0-174.0	01/02/90	87.0-174.0	01/08/90	41.0	26.0	10	5.20	0.916	87.0-174.0	01/12/90	134.00	1.54
A1880	T 18+80.0	15.0	U 5595.70	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	4	10	0.80	1.868	5.5- 29.0	10/16/89	2.40	0.10
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/16/89	25	2	7	0.40	0.127	29.0- 87.0	10/16/89	0.50	0.01
B1882	P 18+82.5	10.0	U 5596.45	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1882	P 18+82.5	10.0	U 5596.45	2	321.00	60.00	1- 2	5.5- 29.0	10/16/89	5.5- 29.0	10/17/89	14	1	7	0.20	0.467	15.0- 29.0	10/18/89		
							- 2	-	/ /	-	/ /						5.5- 15.0	10/18/89	0.10	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	2.00	0.09
							2- 1	29.0- 87.0	10/23/89	29.0- 87.0	10/23/89	25	1	7	0.20	0.063	29.0- 87.0	10/24/89	0.30	0.01
A1885	P 18+85.0	15.0	U 5597.20	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.2- 29.0	09/25/89	12	17.5	18	3.50	4.669	5.5- 29.0	09/27/89	28.90	1.23
							- 2	-	/ /	-	/ /						0.0- 29.0	10/09/89	1.40	0.05
							2- 1	29.0- 87.0	10/03/89	29.0- 86.6	10/04/89	25	9.3	5	1.86	0.593	29.0- 86.6	10/06/89	20.30	0.35
C1887	S 18+87.5	12.5	U 5597.30	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/17/90	5.5- 29.0	01/18/90	4.0	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	01/19/90	29.0- 87.0	01/22/90	25.0	1.0	7	0.20	0.061	29.0- 87.0	01/22/90	1.60	0.03
							3- 1	87.0-174.0	01/23/90	87.0-174.0	01/25/90	53.0	9.7	15	0.97	0.133	87.0-174.0	01/26/90	8.40	0.10
A1890	T 18+90.0	15.0	U 5597.40	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	09/29/89	5	8	12	1.60	3.737	5.5- 29.0	10/16/89	2.00	0.09
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/16/89	25	5.3	7	1.06	0.336	29.0- 87.0	10/16/89	0.60	0.01
B1892	S 18+92.5	10.0	U 5598.05	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/19/89	-	/ /						15.0- 44.0	10/19/89	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 20.5	10/19/89	2.00	0.13
							- 2	-	/ /	-	/ /						5.5- 29.0	10/27/89	3.20	0.14
							2- 1	29.0- 87.0	10/26/89	29.0- 87.0	10/27/89	25.0	0.3	7	0.06	0.019	29.0- 87.0	10/27/89	1.10	0.02
A1895	S 18+95.0	15.0	U 5598.70	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	9.9	12	1.98	2.659	5.5- 29.0	10/16/89	9.30	0.40
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/11/89	25	8	5	1.60	0.507	29.0- 87.0	10/11/89	0.20	0.00
C1897	P 18+97.5	12.5	U 5599.00	3	321.00	60.00	1- 1	0.0- 5.5	11/21/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/08/89	5.5- 29.0	12/08/89	25.0	3.1	7	0.62	0.704	5.5- 29.0	12/08/89	0.20	0.01
							2- 1	29.0- 87.0	12/12/89	29.0- 87.0	12/13/89	25.0	1.9	7	0.38	0.117	29.0- 87.0	12/14/89	1.40	0.02
							3- 1	87.0-174.0	01/03/90	87.0-174.0	01/08/90	41	24	10	4.80	0.846	87.0-174.0	01/09/90	172.10	1.98
A1900	T 19+00.0	15.0	U 5599.30	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	10/02/89	5	4	11	0.80	1.868	5.5- 29.0	10/16/89	1.60	0.07
							2- 1	29.0- 87.0	10/12/89	29.0- 87.0	10/16/89	25	3.3	7	0.66	0.209	29.0- 87.0	10/16/89	2.20	0.04
B1902	P 19+02.5	10.0	U 5599.90	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/17/89	5.5- 29.0	10/17/89	2	100.0	7	20.00	68.360	15.0- 29.0	10/18/89	0.90	0.06

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B1902	P 19+02.5	10.0	U 5599.90	2	321.00	60.00	1- 2	-	/ /	-	/ /						5.5- 15.0	10/18/89	0.30	0.03
							2- 1	29.0- 87.0	10/23/89	29.0- 87.0	10/24/89	25.0	1.2	7	0.24	0.076	29.0- 87.0	10/24/89	0.80	0.01
A1905	P 19+05.0	15.0	U 5600.50	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.5- 29.0	09/25/89	12	4	10	0.80	1.075	5.5- 29.0	09/27/89	2.10	0.09
							- 2	-	/ /	-	/ /						0.0- 29.0	10/09/89	1.40	0.05
							- 2	-	/ /	-	/ /						5.5- 29.0	10/16/89	0.60	0.03
							2- 1	29.0- 87.0	10/04/89	29.0- 86.6	10/04/89	17	18.1	5	3.62	1.521	29.0- 87.0	10/09/89	22.70	0.39
C1907	S 19+07.5	12.5	U 5601.20	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /									
							- 2	5.5- 29.0	01/17/90	5.5- 29.0	01/18/90	4.0	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	01/19/90	29.0- 87.0	01/22/90	25.0	0.4	7	0.08	0.060	-	/ /		
							3- 1	87.0-174.0	01/25/90	87.0-174.0	01/25/90	53.0	11.0	11	1.83	0.251	87.0-174.0	01/29/90	68.10	0.78
A1910	T 19+10.0	15.0	U 5601.90	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	10/02/89	5	2	14	0.40	0.934	5.5- 29.0	10/02/89	1.30	0.06
							2- 1	29.0- 87.0	10/13/89	29.0- 87.0	10/16/89	25	18.5	7	3.70	1.171	29.0- 87.0	10/16/89	16.30	0.28
B1912	S 19+12.5	10.0	U 5602.60	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/28/89	5.0- 29.0	11/30/89	25	1.5	7	0.30	0.337	2.0- 29.0	11/30/89	0.20	0.01
							2- 1	29.0- 87.0	12/04/89	29.0- 87.0	12/05/89	38.0	0.9	7	0.18	0.041	29.0- 87.0	12/06/89	5.60	0.10
A1915	S 19+15.0	15.0	U 5603.30	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/28/89	5.5- 29.0	09/28/89	12	2	17	0.25	0.336	5.5- 29.0	10/16/89	3.30	0.14
							2- 1	29.0- 87.0	10/11/89	29.0- 87.0	10/11/89	25	6	5	1.20	0.380	29.0- 87.0	10/11/89	1.60	0.03
C1917	P 19+17.5	12.5	U 5603.40	3	321.00	60.00	1- 1	0.0- 5.5	11/21/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/08/89	5.5- 29.0	12/08/89	25.0	0.1	7	0.02	0.034	-	/ /		
							2- 1	29.0- 87.0	12/12/89	29.0- 87.0	12/13/89	25.0	0.9	7	0.18	0.055	29.0- 87.0	12/14/89	1.40	0.02
							3- 1	87.0-174.0	01/04/90	87.0-174.0	01/08/90	39.0	23.2	10	4.64	0.858	87.0-174.0	01/10/90	251.90	2.90
A1920	T 19+20.0	15.0	U 5603.50	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/29/89	5.5- 29.0	10/02/89	5	1	17	0.20	0.467	5.5- 29.0	10/16/89	1.60	0.07
							2- 1	29.0- 87.0	10/13/89	29.0- 87.0	10/16/89	25	11.8	14	2.36	0.747	29.0- 87.0	10/16/89	0.60	0.01
B1922	P 19+22.5	10.0	U 5604.40	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/17/89	5.5- 29.0	10/17/89	2	100.	17	20.00	68.360	5.0- 29.0	11/22/89	0.50	0.02
							- 2	-	/ /	5.5- 29.0	10/19/89	14.0	2.9	7	0.58	1.355	-	/ /		
							2- 1	29.0- 87.0	12/01/89	29.0- 87.0	12/01/89	28	2.3	7	0.46	0.130	29.0- 87.0	12/02/89	0.70	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1925	P 19+25.0	15.0	U 5605.30	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.2- 29.0	09/25/89	12	4	26	0.80	1.067	5.5- 29.0	09/27/89	1.20	0.05
							- 2	-	/ /	-	/ /						0.0- 29.0	10/10/89	1.70	0.06
							2- 1	29.0- 61.0	10/04/89	29.0- 61.0	10/04/89	17	17.9	5	3.58	2.814	29.0- 87.0	10/09/89	54.50	0.94
							- 1	-	/ /	29.0- 61.0	10/09/89	25	1	31	0.20	0.115	-	/ /		
							- 2	61.0- 87.0	10/10/89	29.0- 87.0	10/10/89	25	41.0	5	8.20	2.596	61.0- 87.0	10/10/89	53.90	2.07
C1927	S 19+27.5	12.5	U 5605.50	3	321.00	60.00	1- 1	0.0- 5.5	01/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/17/90	5.5- 29.0	01/18/90	4.0	1	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	01/19/90	29.0- 87.0	01/22/90	25.0	0.5	7	0.10	0.075	-	/ /		
							3- 1	87.0-174.0	01/25/90	87.0-174.0	01/29/90	53.0	7.6	10	1.52	0.209	87.0-174.0	01/29/90	0.50	0.01
A1930	T 19+30.0	15.0	U 5605.70	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/01/89	5.5- 29.0	11/01/89	13.0	0.4	7	0.08	0.131	10.0- 29.0	11/02/89	0.20	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.20	0.02
							2- 1	29.0- 87.0	11/15/89	29.0- 87.0	11/17/89	38	10.7	7	2.14	0.487	29.0- 87.0	11/17/89	5.60	0.10
B1932	S 19+32.5	10.0	U 5605.95	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.0- 29.0	11/27/89	5.0- 29.0	11/30/89	25.0	1.5	7	0.30	0.337	5.5- 29.0	11/30/89	0.20	0.01
							2- 1	29.0- 87.0	12/04/89	29.0- 87.0	12/05/89	38.0	0.8	7	0.16	0.036	29.0- 87.0	12/06/89	1.50	0.03
A1935	S 19+35.0	15.0	U 5606.20	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/30/89	5.5- 29.0	10/31/89	13.0	0.1	7	0.02	0.033	10.0- 29.0	10/31/89		
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	0.20	0.02
							2- 1	29.0- 70.0	11/07/89	29.0- 87.0	11/09/89	25	10.9	7	2.18	0.690	29.0- 70.0	11/10/89	4.30	0.10
							- 1	-	/ /	-	/ /						29.0- 87.0	11/13/89	48.90	0.84
							- 2	70.0- 87.0	11/11/89	70.0- 87.0	11/13/89	77.0	16.0	7	3.20	2.296	-	/ /		
C1937	P 19+37.5	12.5	U 5606.55	3	321.00	60.00	1- 1	0.0- 5.5	11/21/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/08/89	5.5- 29.0	12/08/89	25.0	0.2	7	0.04	0.068	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/13/89	25.0	0.5	7	0.10	0.031	29.0- 87.0	12/14/89	1.20	0.02
							3- 1	87.0-174.0	01/04/90	87.0-174.0	01/08/90	41.0	20.4	10	4.08	0.719	87.0-174.0	01/11/90	199.70	2.30
A1940	T 19+40.0	15.0	U 5606.90	1	321.00	60.00	1- 1	0.0- 5.5	09/25/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/01/89	5.5- 9.0	11/02/89	13.0	1.1	10	0.22	2.140	10.0- 29.0	11/02/89	0.30	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.20	0.02
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/17/89	38	5.1	7	1.02	0.232	29.0- 87.0	11/17/89	5.10	0.09
C1942	T 19+42	12.5	U 5607.00	1	321.00	60.00	1- 1	0.0- 5.5	01/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/24/90	5.5- 29.0	01/24/90	5.0	1	7	0.20		-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C1942	T 19+42	12.5	U 5607.00	1	321.00	60.00	2- 1	29.0- 87.0	01/24/90	29.0- 87.0	01/25/90	25.0	1	7	0.20		-	/ /		
							3- 1	87.0-174.0	01/26/90	87.0-174.0	01/29/90	42.0	28.4	15	2.84		87.0-174.0	01/30/90	232.50	2.67
B1942	P 19+42.5	10.0	U 5607.00	2	321.00	60.00	1- 1	0.0- 5.5	10/06/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/21/89	5.0- 29.0	11/21/89	25	6	7	1.20	1.347	5.0- 29.0	11/22/89	0.40	0.02
							2- 1	29.0- 87.0	12/01/89	29.0- 87.0	12/01/89	28	3.4	7	0.68	0.192	29.0- 87.0	12/02/89	1.70	0.03
A1945	P 19+45.0	15.0	U 5607.10	1	321.00	60.00	1- 1	0.0- 5.5	09/19/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	09/22/89	5.5- 29.0	10/24/89	13	1.5	7	0.30	0.493	5.5- 29.0	10/24/89	3.00	0.13
							- 2	-	/ /	-	/ /						0.0- 29.0	11/14/89	2.80	0.10
							2- 1	29.0- 87.0	11/03/89	29.0- 87.0	11/06/89	18.0	28.0	7	5.60	2.336	29.0- 87.0	11/06/89	42.40	0.73
C1947	S 19+47.5	12.5	U 5607.10	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/12/89	5.5- 29.0	12/12/89	5.0	0.2	7	0.04	0.295	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/15/89	25.0	1.0	7	0.20	0.063	29.0- 87.0	12/18/89	1.60	0.03
							3- 1	87.0-174.0	01/15/90	87.0-174.0	01/17/90	51.0	13.3	10	2.66	0.448	87.0-174.0	01/22/90	143.60	1.65
A1950	T 19+50.0	15.0	U 5608.60	1	321.00	60.00	1- 2	5.5- 29.0	11/01/89	5.5- 29.0	11/02/89	13.0	1.0	7	0.20	0.328	10.0- 29.0	11/02/89	0.40	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.60	0.06
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/17/89	38	6.9	7	1.38	0.314	29.0- 87.0	11/17/89	2.90	0.05
C1952	T 19+52	12.5	U 5607.90	1	321.00	60.00	1- 1	0.0- 5.5	01/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/24/90	5.5- 29.0	01/24/90	5.0	1	7	0.20		-	/ /		
							2- 1	29.0- 87.0	01/24/90	29.0- 87.0	01/25/90	25.0	3	7	0.60		-	/ /		
							3- 1	87.0-174.0	01/26/90	87.0-174.0	01/29/90	53.0	5.0	10	1.00		87.0-174.0	01/30/90	3.10	0.04
B1952	S 19+52.5	10.0	U 5607.90	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.0- 29.0	11/27/89	5.0- 29.0	11/30/89	25.0	2.4	7	0.48	0.539	2.0- 29.0	11/30/89	1.80	0.07
							2- 1	29.0- 87.0	12/05/89	29.0- 87.0	12/05/89	38.0	3.1	7	0.62	0.141	29.0- 87.0	12/06/89	3.80	0.07
A1955	S 19+55.0	15.0	U 5608.25	1	321.00	60.00	1- 1	0.0- 5.5	10/17/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/30/89	5.5- 29.0	10/31/89	13.0	1.0	7	0.20	0.328	10.0- 29.0	10/31/89	0.30	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	0.10	0.01
							2- 1	29.0- 70.0	11/07/89	29.0- 87.0	11/09/89	25	13.2	7	2.64	0.836	29.0- 70.0	11/10/89	53.20	1.30
							- 2	70.0- 87.0	11/11/89	70.0- 87.0	11/13/89	77.0	14.5	7	2.90	1.199	70.0- 87.0	11/14/89	103.10	6.06
C1957	P 19+57.5	12.5	U 5608.53	3	321.00	60.00	1- 1	0.0- 5.5	12/07/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7.0	0.1	7	0.02	0.148	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/13/89	25.0	2.4	7	0.48	0.148	29.0- 87.0	12/14/89	1.80	0.03
							3- 1	87.0-174.0	01/04/90	87.0-174.0	01/08/90	41.0	25.0	10	5.00	0.881	87.0-174.0	01/11/90	105.10	1.21

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1960	T 19+60.0	15.0	U 5608.80	1	321.00	60.00	1- 1	0.0- 5.5	10/17/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/01/89	5.5- 29.0	11/02/89	13.0	1.2	7	0.24	0.394	10.0- 29.0	11/02/89	0.20	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.20	0.02
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/17/89	38.0	1.6	7	0.32	0.073	29.0- 87.0	11/18/89	3.90	0.07
B1962	P 19+62.5	10.0	U 5609.10	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/21/89	5.0- 29.0	11/21/89	25	2.3	7	0.46	0.516	5.0- 29.0	11/22/89	0.20	0.01
							2- 1	29.0- 87.0	12/01/89	29.0- 87.0	12/01/89	35	15.2	7	3.04	0.723	29.0- 87.0	12/02/89	5.10	0.09
A1965	P 19+65.0	15.0	U 5609.40	1	321.00	60.00	1- 1	0.0- 5.5	10/17/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/23/89	5.5- 29.0	10/24/89	13.0	0.8	7	0.16	0.263	15.0- 29.0	10/24/89	6.70	0.48
							- 2	-	/ /	-	/ /						0.0- 29.0	11/14/89	3.10	0.11
							2- 1	29.0- 87.0	11/03/89	29.0- 87.0	11/06/89	18.0	23.8	7	4.76	1.986	29.0- 87.0	11/06/89	32.20	0.56
C1967	S 19+67.5	12.5	U 5609.58	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/12/89	5.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.148	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/15/89	25.0	0.5	7	0.10	0.032	29.0- 87.0	12/18/89	1.10	0.02
							3- 1	87.0-174.0	01/15/90	-	/ /						87.0-174.0	01/19/90	79.20	0.91
A1970	T 19+70.0	15.0	U 5609.75	1	321.00	60.00	1- 1	0.0- 5.5	10/17/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/01/89	5.5- 29.0	11/02/89	13.0	0.7	7	0.14	0.230	10.0- 29.0	11/02/89	0.50	0.03
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.20	0.02
							2- 1	29.0- 87.0	11/17/89	29.0- 87.0	11/17/89	38.0	5.9	7	1.18	0.268	29.0- 87.0	11/18/89	5.40	0.09
B1972	S 19+72.5	10.0	U 5609.90	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.0- 29.0	11/27/89	5.0- 29.0	11/30/89	25	3.4	7	0.68	0.763	5.5- 29.0	11/30/89	0.20	0.01
							2- 1	29.0- 87.0	12/05/89	29.0- 87.0	12/06/89	38.0	8.9	7	1.78	0.405	29.0- 87.0	12/06/89	3.20	0.06
A1975	S 19+75.0	15.0	U 5610.10	1	321.00	60.00	1- 1	0.0- 5.5	10/17/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/31/89	5.5- 29.0	10/31/89	13.0	0.7	7	0.14	0.230	10.0- 29.0	10/31/89	0.30	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	1.10	0.11
							2- 1	29.0- 70.0	11/08/89	29.0- 87.0	11/09/89	25	5.3	7	1.06	0.336	29.0- 70.0	11/10/89	0.70	0.02
							- 2	70.0- 87.0	11/13/89	70.0- 87.0	11/14/89	37.7	10.0	7	2.00	1.232	70.0- 87.0	11/14/89	114.70	6.75
C1977	P 19+77.5	12.5	U 5610.28	3	321.00	60.00	1- 1	0.0- 5.5	12/07/89	-	/ /						0.0- 5.5	01/15/90	14.70	2.67
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7.0	0.2	7	0.04	0.295	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/14/89	25.0	1.8	7	0.36	0.114	29.0- 87.0	12/14/89	0.50	0.01
							3- 1	87.0-174.0	01/05/90	87.0-174.0	01/08/90	41.0	22.7	10	4.54	0.800	87.0-174.0	01/11/90	105.60	1.21
A1980	T 19+80.0	15.0	U 5610.45	1	321.00	60.00	1- 1	0.0- 5.5	10/17/89	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A1980	T 19+80.0	15.0	U 5610.45	1	321.00	60.00	1- 2	5.5- 29.0	11/01/89	5.5- 29.0	11/02/89	13.0	1.4	7	0.28	0.460	10.0- 29.0	11/02/89	0.40	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89		
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/17/89	38.0	4.2	7	0.84	0.191	29.0- 87.0	11/18/89	1.90	0.03
B1982	P 19+82.5	10.0	U 5610.60	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.0- 29.0	11/21/89	5.0- 29.0	11/21/89	25	1.9	7	0.38	0.427	5.5- 29.0	11/22/89	0.20	0.01
							2- 1	29.0- 87.0	12/01/89	29.0- 87.0	12/02/89	38	3.2	7	0.64	0.143	29.0- 87.0	12/02/89	1.30	0.02
A1985	P 19+85.0	15.0	U 5610.80	1	321.00	60.00	1- 1	0.0- 5.5	10/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/23/89	5.5- 29.0	10/24/89	13.0	0.5	7	0.10	0.164	0.0- 29.0	11/14/89	5.90	0.20
							2- 1	29.0- 87.0	11/04/89	29.0- 87.0	11/06/89	18.0	18.5	7	3.70	1.543	29.0- 87.0	11/06/89	21.20	0.37
C1987	S 19+87.5	12.5	U 5610.95	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/12/89	5.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.148	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/15/89	25.0	0.5	7	0.10	0.032	29.0- 87.0	12/18/89	0.90	0.02
							3- 1	87.0-174.0	01/16/90	87.0-174.0	01/17/90	61.0	9.7	10	1.94	0.266	87.0-174.0	01/18/90	7.30	0.08
A1990	T 19+90.0	15.0	U 5611.10	1	321.00	60.00	1- 1	0.0- 5.5	10/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/01/89	5.5- 29.0	11/02/89	13.0	0.7	17	0.14	0.230	10.0- 29.0	11/02/89	0.20	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.20	0.02
							2- 1	29.0- 87.0	11/16/89	29.0- 87.0	11/18/89	38.0	12.2	7	2.44	0.555	29.0- 87.0	11/18/89	31.60	0.54
B1992	S 19+92.5	10.0	U 5611.25	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/28/89	5.0- 29.0	11/30/89	25.0	0.7	7	0.14	0.157	2.0- 29.0	11/30/89	0.20	0.01
							2- 1	29.0- 87.0	12/05/89	29.0- 87.0	12/06/89	38.0	4.5	7	0.90	0.205	29.0- 87.0	12/06/89	0.80	0.01
A1995	S 19+95.0	15.0	U 5611.40	1	321.00	60.00	1- 1	0.0- 5.5	10/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	10/31/89	5.5- 29.0	10/31/89	13.0	0.3	7	0.06	0.099	10.0- 29.0	10/31/89	0.10	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	0.10	0.01
							2- 1	29.0- 80.0	11/08/89	29.0- 87.0	11/09/89	25	14.8	9	2.96	0.937	29.0- 81.0	11/10/89	25.50	0.49
							- 2	80.0- 87.0	11/13/89	80.0- 87.0	11/14/89	75	17	17	3.40	2.610	80.0- 87.0	11/14/89	1.60	0.23
C1997	P 19+97.5	12.5	U 5611.55	3	321.00	60.00	1- 1	0.0- 5.5	12/07/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/11/89	5.5- 29.0	12/11/89	7.0	0.2	7	0.04	0.295	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/14/89	25.0	2.7	7	0.54	0.171	29.0- 87.0	12/14/89	1.80	0.03
							3- 1	87.0-174.0	01/05/90	87.0-174.0	01/08/90	44.0	24.1	10	4.82	0.793	87.0-174.0	01/12/90	4.00	0.05
A2000	T 20+00.0	15.0	U 5611.70	1	321.00	60.00	1- 1	0.0- 5.5	10/18/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/02/89	5.5- 29.0	11/02/89	13.0	1.0	7	0.20	0.328	10.0- 29.0	11/02/89	0.50	0.03
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.10	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
A2000	T 20+00.0	15.0	U 5611.70	1	321.00	60.00	2- 1	29.0- 87.0	11/17/89	29.0- 87.0	11/18/89	38.0	10.6	7	2.12	0.482	29.0- 87.0	11/18/89	1.10	0.02
B2002	P 20+02.5	10.0	U 5611.85	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.0- 29.0	11/21/89	5.0- 29.0	11/21/89	25	4	7	0.80	0.898	5.5- 29.0	11/22/89	0.50	0.02
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/02/89	38	6.2	7	1.24	0.276	28.0- 86.0	12/02/89	1.70	0.03
A2005	P 20+05.0	15.0	U 5612.00	1	321.00	60.00	1- 1	0.0- 5.0	10/18/89	-	/ /						-	/ /		
							- 2	5.0- 29.0	10/23/89	5.5- 29.0	10/24/89	13.0	0.4	7	0.08	0.131	0.0- 29.0	11/14/89	4.80	0.17
							2- 1	29.0- 87.0	11/04/89	29.0- 87.0	11/06/89	21.0	24.5	7	4.90	1.827	29.0- 87.0	11/07/89	152.70	2.63
C2007	S 20+07.5	12.5	U 5612.18	3	321.00	60.00	1- 1	0.0- 5.5	12/08/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	12/12/89	5.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.148	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/18/89	25.0	0.6	7	0.12	0.038	29.0- 87.0	12/18/89	0.20	0.00
							3- 1	87.0-174.0	01/16/90	87.0-174.0	01/17/90	61.0	7.1	10	1.42	0.195	87.0-174.0	01/18/90	20.20	0.23
A2010	T 20+10.0	15.0	U 5612.35	1	321.00	60.00	1- 1	0.0- 4.0	10/18/89	-	/ /						-	/ /		
							- 2	4.0- 29.0	11/02/89	5.5- 29.0	11/02/89	13.0	4.5	7	0.90	1.478	10.0- 29.0	11/03/89	4.10	0.22
							- 2	-	/ /	-	/ /						0.0- 10.0	11/03/89	0.20	0.02
							2- 1	29.0- 87.0	11/17/89	29.0- 87.0	11/18/89	38.0	6.9	7	1.38	0.314	29.0- 87.0	11/20/89	5.40	0.09
B2012	S 20+12.5	10.0	U 5612.50	2	321.00	60.00	1- 1	0.0- 5.5	11/07/89	-	/ /						-	/ /		
							- 2	5.5- 29.0	11/30/89	5.0- 29.0	11/30/89	25.0	0.4	7	0.08	0.090	2.0- 29.0	11/30/89	0.70	0.03
							2- 1	29.0- 87.0	12/06/89	29.0- 87.0	12/06/89	38.0	2.2	7	0.44	0.100	29.0- 87.0	12/06/89	1.30	0.02
A2015	S 20+15.0	15.0	U 5612.70	1	321.00	60.00	1- 1	0.0- 3.0	10/18/89	-	/ /						-	/ /		
							- 2	3.0- 29.0	10/31/89	5.5- 29.0	10/31/89	13.0	0.6	7	0.12	0.197	10.0- 29.0	10/31/89	0.20	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	0.60	0.06
							2- 1	29.0- 55.0	11/09/89	29.0- 55.0	11/10/89	14.0	16.3	7	3.26	2.920	29.0- 55.0	11/11/89	114.90	4.42
							- 2	55.0- 87.0	11/13/89	55.0- 87.0	11/14/89	60.0	14.0	7	2.80	0.811	55.0- 87.0	11/15/89	66.20	2.07
C2017	P 20+17.5	12.5	U 5612.88	3	321.00	60.00	1- 1	0.0- 3.5	12/07/89	-	/ /						-	/ /		
							- 2	3.5- 29.0	12/11/89	3.5- 29.0	12/11/89	7.0	0.1	7	0.02	0.138	-	/ /		
							2- 1	29.0- 87.0	12/13/89	29.0- 87.0	12/14/89	25.0	1.1	7	0.22	0.070	29.0- 87.0	12/14/89	0.10	0.00
							3- 1	87.0-174.0	01/05/90	87.0-174.0	01/08/90	53.0	19.1	10	3.82	0.525	87.0-174.0	01/12/90	95.80	1.10
A2020	T 20+20.0	15.0	U 5613.05	1	321.00	60.00	1- 1	0.0- 2.0	10/18/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/02/89	5.5- 29.0	11/02/89	13.0	1.7	7	0.34	0.558	10.0- 29.0	11/03/89	0.40	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	11/03/89	0.10	0.01
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/18/89	38.0	8.5	7	1.70	0.387	29.0- 87.0	11/20/89	2.90	0.05

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2022	P 20+22.5	10.0	U 5613.20	2	321.00	60.00	1- 1	0.0- 2.0	11/07/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/21/89	1.0- 29.0	11/22/89	25.0	2.4	7	0.48	0.495	2.0- 29.0	11/22/89	0.30	0.01
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/02/89	38	6.2	7	1.24	0.276	29.0- 87.0	12/04/89	2.80	0.05
A2025	P 20+25.0	15.0	U 5613.40	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	10/23/89	5.5- 29.0	10/27/89	13.5	2.6	7	0.52	0.854	0.0- 29.0	11/14/89	11.20	0.39
							2- 1	29.0- 87.0	11/04/89	29.0- 87.0	11/07/89	25.0	19.4	7	3.88	1.228	29.0- 87.0	11/07/89	55.10	0.95
C2027	S 20+27.5	12.5	U 5613.50	3	321.00	60.00	1- 1	0.0- 2.0	12/08/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	12/12/89	2.0- 29.0	12/12/89	5.0	0.1	7	0.02	0.132	-	/ /		
							2- 1	29.0- 87.0	12/15/89	29.0- 87.0	12/18/89	25.0	0.7	7	0.14	0.044	29.0- 87.0	12/18/89	0.30	0.01
							3- 1	87.0-174.0	01/17/90	87.0-174.0	01/18/90	61.0	4.6	10	0.92	0.126	87.0-174.0	01/19/90	22.20	0.26
A2030	T 20+30.0	15.0	U 5613.60	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/02/89	5.5- 29.0	11/02/89	13.0	01	7	0.20	0.328	10.0- 29.0	11/03/89	0.50	0.03
							- 2	-	/ /	-	/ /						0.0- 10.0	11/03/89	1.10	0.11
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/19/89	38.0	13.2	7	3.30	0.751	29.0- 87.0	11/20/89	17.70	0.31
D2032	P 20+32	15.0	U 5613.60	4	260.00	60.00	1- 2	0.0- 15.0	05/23/90	1.0- 15.0	05/25/90	3	2	7	0.40	2.676	1.0- 15.0	05/25/90	0.40	0.03
B2032	S 20+32.5	10.0	U 5613.70	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/30/89	-	/ /						5.0- 29.0	12/01/89	17.60	0.73
							2- 1	29.0- 87.0	12/06/89	29.0- 87.0	12/06/89	38.0	1.2	7	0.24	0.055	29.0- 87.0	12/07/89	1.10	0.02
A2035	S 20+35.0	15.0	U 5613.85	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	10/31/89	5.5- 29.0	10/31/89	13.0	2.3	7	0.46	0.755	10.0- 29.0	11/01/89	3.30	0.17
							- 2	-	/ /	-	/ /						0.0- 10.0	11/01/89	1.50	0.15
							2- 1	29.0- 87.0	11/10/89	29.0- 87.0	11/10/89	25.0	7.2	17	1.44	0.456	29.0- 87.0	11/15/89	18.30	0.32
							- 1	-	/ /	29.0- 87.0	11/15/89	47.5	19.4	7	3.88	0.739	-	/ /		
C2037	P 20+37.5	12.5	U 5613.46	3	321.00	60.00	1- 1	0.0- 1.5	12/07/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/11/89	1.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.130	-	/ /		
							2- 1	29.0- 87.0	12/14/89	29.0- 87.0	12/14/89	25.0	1.4	7	0.28	0.089	29.0- 87.0	12/14/89	0.70	0.01
							3- 1	87.0-174.0	01/05/90	87.0-174.0	01/08/90	53.0	14.0	10	2.80	0.385	87.0-174.0	01/12/90	1.20	0.01
A2040	T 20+40.0	15.0	U 5614.07	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/02/89	5.5- 29.0	11/02/89	13.0	0.2	7	0.04	0.066	10.0- 29.0	11/03/89	1.50	0.08
							- 2	-	/ /	-	/ /						0.0- 10.0	11/03/89	0.20	0.02
							2- 1	29.0- 87.0	11/18/89	29.0- 87.0	11/19/89	38.0	2.6	7	0.52	0.118	29.0- 87.0	11/20/89	0.80	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
B2042	P 20+42.5	10.0	U 5614.20	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/22/89	1.0- 29.0	11/22/89	25.0	0.8	7	0.16	0.165	1.0- 29.0	11/22/89	0.10	0.00
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/04/89	38.0	2.6	7	0.52	0.118	29.0- 87.0	12/04/89	1.50	0.03
C2042	T 20+42.5	12.5	U 5614.20	3	321.00	60.00	1- 1	0.0- 1.5	12/19/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/20/89	1.5- 29.0	12/20/89	5.00	3	7	0.60	3.895	-	/ /		
							2- 1	29.0- 87.0	12/20/89	29.0- 87.0	12/21/89	38.0	0.2	7	0.04	0.009	29.0- 87.0	12/21/89	2.60	0.04
D2043	P 20+43	12.5	U 5614.50	4	92.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/25/90	3	01	7	0.20	2.561	1.0- 10.0	05/25/90	0.40	0.04
A2045	P 20+45.0	15.0	U 5614.30	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	10/24/89	5.5- 29.0	10/27/89	13.5	5.1	7	1.02	1.675	10.0- 29.0	10/30/89	0.20	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	10/30/89	1.80	0.18
							- 2	-	/ /	-	/ /						0.0- 29.0	11/14/89	1.40	0.05
							2- 1	29.0- 87.0	11/06/89	29.0- 87.0	11/07/89	22.0	20.2	7	4.04	1.406	29.0- 87.0	11/08/89	382.90	6.60
C2047	S 20+47.5	12.5	U 5614.45	3	321.00	60.00	1- 1	0.0- 1.5	12/08/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/12/89	1.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.130	-	/ /		
							2- 1	29.0- 87.0	12/18/89	29.0- 87.0	12/18/89	38.0	1.4	7	0.28	0.065	29.0- 87.0	12/18/89	26.70	0.46
							3- 1	87.0-174.0	01/17/90	87.0-174.0	01/18/90	61.0	4.4	10	0.88	0.121	87.0-174.0	01/19/90	1.60	0.02
A2050	T 20+50.0	15.0	U 5614.60	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/02/89	5.5- 29.0	11/02/89	13.0	0.5	7	0.10	0.164	10.0- 29.0	11/03/89	3.30	0.17
							- 2	-	/ /	-	/ /						0.0- 10.0	11/03/89	0.20	0.02
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/20/89	38.0	6.3	12	0.63	0.143	29.0- 87.0	11/20/89	91.30	1.57
B2052	S 20+52.5	10.0	U 5614.75	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/30/89	5.0- 29.0	11/30/89	25.0	0.5	7	0.10	0.112	5.0- 29.0	12/01/89	1.10	0.05
							2- 1	29.0- 87.0	12/06/89	29.0- 87.0	12/07/89	38.0	0.4	7	0.08	0.018	29.0- 87.0	12/07/89	0.80	0.01
C2052	T 20+52.5	12.5	U 5614.20	3	321.00	60.00	1- 1	0.0- 1.5	12/19/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/20/89	1.5- 29.0	12/20/89	5.0	2	7	0.40	2.597	-	/ /		
							2- 1	29.0- 87.0	12/20/89	29.0- 87.0	12/21/89	38.0	0.8	7	0.16	0.036	29.0- 87.0	12/21/89	1.50	0.03
D2053	P 20+53	13.5	U 5614.90	4	360.00	90.00	1- 1	0.0- 2.5	05/10/90	-	/ /						-	/ /		
							- 2	2.5- 10.0	05/23/90	1.0- 10.0	05/25/90	3	13	7	2.60	27.989	1.0- 10.0	05/25/90	0.80	0.09
A2055	S 20+55.0	15.0	U 5614.90	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	10/31/89	5.5- 29.0	11/01/89	13.0	0.4	7	0.08	0.131	10.0- 29.0	11/01/89	16.50	0.87
							- 2	-	/ /	-	/ /						0.0- 10.0	11/01/89	3.40	0.34

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2055	S 20+55.0	15.0 U	5614.90	1	321.00	60.00	2- 1	29.0- 87.0	11/15/89	29.0- 87.0	11/15/89	38.0	5.3	7	1.06	0.226	29.0- 87.0	11/16/89	5.10	0.09
C2057	P 20+57.5	12.5 U	5615.05	3	321.00	60.00	1- 1	0.0- 1.5	12/07/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/11/89	1.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.130	-	/ /		
							2- 1	29.0- 87.0	12/14/89	29.0- 87.0	12/14/89	25.0	1.0	7	0.20	0.063	29.0- 87.0	12/14/89	0.80	0.01
							3- 1	87.0-174.0	01/04/90	87.0-174.0	01/08/90	53.0	16.1	10	3.22	0.442	87.0-174.0	01/16/90	85.70	0.99
A2060	T 20+60.0	15.0 U	5615.20	1	321.00	60.00	1- 1	0.0- 1.5	10/18/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	11/02/89	5.5- 29.0	11/03/89	13.0	0.01	7	0.00		10.0- 29.0	11/03/89	0.10	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	11/03/89	0.30	0.03
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/20/89	38.0	22.3	12	2.23	0.507	29.0- 87.0	11/21/89	7.40	0.13
B2062	P 20+62.5	10.0 U	5615.35	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/22/89	1.0- 29.0	11/22/89	25.0	1.6	7	0.32	0.330	1.0- 29.0	11/22/89		
							2- 1	29.0- 87.0	12/02/89	29.0- 87.0	12/04/89	38.0	1.5	7	0.30	0.068	29.0- 87.0	12/04/89	0.90	0.02
A2065	P 20+65.0	15.0 U	5615.50	1	321.00	60.00	1- 1	0.0- 2.0	10/19/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	10/26/89	5.5- 29.0	10/27/89	13.5	2.8	7	0.56	0.920	10.0- 39.0	10/30/89	0.40	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	10/30/89	0.30	0.03
							- 2	-	/ /	-	/ /						0.0- 29.0	11/14/89	1.40	0.05
							2- 1	29.0- 87.0	11/06/89	29.0- 87.0	11/07/89	22.0	23.4	7	4.68	1.577	29.0- 87.0	11/08/89	162.30	2.80
A2070	T 20+70.0	15.0 U	5615.70	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/02/89	5.5- 29.0	11/03/89	13.0	1.1	7	0.22	0.361	10.0- 29.0	11/03/89	1.30	0.07
							2- 1	29.0- 87.0	11/19/89	29.0- 87.0	11/20/89	38	12.9	12	1.29	0.294	29.0- 87.0	11/21/89	11.70	0.20
B2072	S 20+72.5	10.0 U	5615.80	2	321.00	60.00	1- 1	0.0- 2.0	11/07/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/30/89	-	/ /						5.0- 29.0	12/01/89	0.90	0.04
							2- 1	29.0- 87.0	12/07/89	29.0- 87.0	12/07/89	38.0	2.1	7	0.42	0.096	29.0- 87.0	12/07/89	3.10	0.05
D2073	P 20+73	11.0 U	5615.90	4	110.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/25/90	3	27	7	5.40	69.141	1.0- 10.0	05/25/90	2.40	0.27
A2075	S 20+75.0	15.0 U	5615.90	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/01/89	5.5- 29.0	11/01/89	13.0	0.7	7	0.14	0.230	10.0- 29.0	11/02/89	0.40	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.10	0.01
							2- 1	29.0- 87.0	11/14/89	29.0- 87.0	11/16/89	38	11.3	7	2.26	0.514	29.0- 87.0	11/16/89	117.40	2.02
C2077	P 20+77.5	12.5 U	5616.00	3	321.00	60.00	1- 1	0.0- 1.5	12/07/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	12/11/89	1.5- 29.0	12/12/89	5.0	0.1	7	0.02	0.045	3.5- 29.0	03/06/90	0.60	0.02
							2- 1	29.0- 87.0	01/04/90	29.0- 87.0	01/08/90	38.0	1.0	7	0.20	0.078	-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2077	P 20+77.5	12.5	U 5616.00	3	321.00	60.00	2- 1	-	/ /	29.0- 87.0	03/06/90	25	6	7	1.20	0.901	-	/ /		
							3- 1	87.0-174.0	03/13/90	87.0-174.0	03/14/90	53.	4.8	12	0.96	0.132	87.0-174.0	03/14/90	49.50	0.57
A2080	T 20+80.0	15.0	U 5616.10	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/02/89	5.5- 29.0	11/03/89	13.0	1.2	7	0.24	0.394	10.0- 29.0	11/03/89	0.20	0.01
							2- 1	29.0- 40.0	05/04/93	29.0- 87.0	11/21/89	38	5.6	20	1.40	0.319	29.0- 87.0	11/21/89	0.30	0.01
							- 2	40.0- 87.0	11/20/89	-	/ /						-	/ /		
B2082	P 20+82.5	10.0	U 5616.10	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/22/89	1.0- 29.0	11/22/89	25.0	0.1	7	0.02	0.021	5.0- 29.0	12/01/89	0.40	0.02
							2- 1	29.0- 87.0	12/04/89	29.0- 87.0	12/04/89	38.0	1.0	7	0.20	0.046	29.0- 87.0	12/04/89	0.40	0.01
A2085	P 20+85.0	15.0	U 5616.30	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	10/27/89	5.5- 29.0	10/30/89	13.5	6.3	7	1.26	2.069	10.0- 29.0	10/30/89	4.40	0.23
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	0.30	0.03
							2- 1	29.0- 40.0	11/06/89	29.0- 87.0	11/07/89	18.0	21.7	7	4.34	1.810	29.0- 87.0	11/09/89	252.30	4.35
							- 2	40.0- 87.0	11/10/89	40.0- 87.0	11/11/89	38.0	1.1	7	0.22	0.060	40.0- 87.0	11/11/89	0.40	0.01
C2087	S 20+87.5	12.5	U 5616.45	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/15/90	3.0- 29.0	03/15/90	7	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/19/90	15.0- 87.0	03/20/90	25	59	7	11.80	3.245	2.5- 87.0	03/21/90	0.50	0.01
A2090	T 20+90.0	15.0	U 5616.60	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/03/89	5.5- 29.0	11/03/89	13.0	4.2	7	0.84	1.379	10.0- 29.0	11/03/89	2.20	0.12
							2- 1	29.0- 87.0	11/20/89	29.0- 87.0	11/21/89	38	6.7	7	1.34	0.305	29.0- 87.0	11/21/89		
D2091	P 20+91	18.0	U 5616.80	4	285.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/25/90	3	25	7	5.00	64.019	1.0- 10.0	05/25/90	0.40	0.04
B2092	S 20+92.5	10.0	U 5616.75	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	1.3	7	0.26	0.374	1.0- 29.0	02/27/90	0.20	0.01
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/02/90	25	1.0	7	0.20	0.061	29.0- 87.0	03/02/90	1.20	0.02
A2095	S 20+95.0	15.0	U 5616.90	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/01/89	5.5- 29.0	11/01/89	13.0	1.0	7	0.20	0.328	10.0- 29.0	11/02/89	0.40	0.02
							- 2	-	/ /	-	/ /						0.0- 10.0	11/02/89	0.60	0.06
							2- 1	29.0- 87.0	11/13/89	29.0- 87.0	11/16/89	38	1.3	17	0.26	0.059	29.0- 87.0	11/16/89	0.40	0.01
C2097	P 20+97.5	12.5	U 5617.05	3	321.00	60.00	1- 1	0.0- 1.5	12/07/89	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/06/90	1.5- 29.0	03/06/90	5	15	7	3.00	19.476	-	/ /		
							2- 1	29.0- 87.0	03/08/90	29.0- 87.0	03/09/90	25	3.7	7	0.74	0.227	29.0- 87.0	03/12/90	22.90	0.39

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2097	P 20+97.5	12.5	U 5617.05	3	321.00	60.00	3- 1	87.0-174.0	03/14/90	87.0-174.0	03/14/90	53.0	8.2	12	1.64	0.225	87.0-174.0	03/15/90	77.90	0.90
D2099	P 20+99	16.5	U 5617.40	4	321.00	45.00	1- 2	0.0- 10.0	05/23/90	-	/ /						1.0- 10.0	05/25/90	16.60	1.84
A2100	T 21+00.0	15.0	U 5617.20	1	321.00	60.00	1- 1	0.0- 2.0	10/19/89	-	/ /						-	/ /		
							- 2	2.0- 29.0	11/03/89	5.5- 29.0	11/03/89	13.0	1.0	7	0.20	0.328	10.0- 29.0	11/03/89	0.20	0.01
							2- 1	29.0- 87.0	11/20/89	29.0- 87.0	11/21/89	38	5.3	7	1.06	0.241	29.0- 87.0	11/22/89	5.00	0.09
B2102	P 21+02.5	10.0	U 5617.35	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	11/30/89	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	15.0- 29.0	02/23/90		
							- 2	-	/ /	-	/ /						1.5- 29.0	02/23/90		
							2- 1	29.0- 87.0	02/27/90	29.0- 87.0	02/28/90	25.0	0.1	7	0.02	0.006	29.0- 87.0	03/02/90	0.90	0.02
A2105	P 21+05.0	15.0	U 5617.50	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	10/27/89	5.5- 29.0	10/30/89	13.5	1.2	7	0.24	0.394	10.0- 29.0	10/31/89	0.10	0.01
							- 2	-	/ /	-	/ /						0.0- 10.0	10/31/89	4.10	0.41
							2- 1	29.0- 70.0	11/06/89	29.0- 87.0	11/07/89	22.0	18.4	7	4.60	1.550	29.0- 87.0	11/09/89	78.50	1.35
							- 2	70.0- 87.0	11/10/89	70.0- 87.0	11/11/89	38.0	3.2	7	0.64	0.380	70.0- 87.0	11/11/89	12.70	0.75
C2107	S 21+07.5	12.5	U 5617.55	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/15/90	3.0- 29.0	03/15/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/19/90	15.0- 87.0	03/20/90	25	11	7	2.20	0.605	2.5- 87.0	03/21/90	0.90	0.01
A2110	T 21+10.0	15.0	U 5617.60	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	01/26/90	15.0- 29.0	01/30/90	22	01	7	0.20	0.288	15.0- 29.0	01/30/90	0.90	0.06
							- 2	-	/ /	-	/ /						5.5- 29.0	01/30/90	1.10	0.05
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	02/19/90	29	4.5	7	0.90	0.248	29.0- 87.0	02/20/90	1.30	0.02
B2112	S 21+12.5	10.0	U 5617.80	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	02/26/90	15.0- 29.0	02/27/90	22	1	7	0.20	0.288	1.0- 29.0	02/27/90	0.20	0.01
B2112	S 21+12.5	10.0	U 5617.80	2	321.00	60.00	2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/02/90	25	0.5	7	0.10	0.031	29.0- 87.0	03/02/90	0.30	0.01
A2115	S 21+15.0	15.0	U 5617.85	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	01/22/90	10.0- 29.0	01/23/90	14	06	7	1.20	1.819	15.0- 29.0	01/23/90	0.30	0.02
							- 2	-	/ /	-	/ /						5.0- 15.0	01/23/90	1.80	0.18
							2- 1	29.0- 87.0	02/09/90	29.0- 87.0	02/12/90	25.0	1.7	7	0.34	0.105	29.0- 87.0	02/13/90	7.90	0.14
D2116	P 21+16	18.0	U 5617.80	4	141.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/25/90	3	43	7	8.60	110.113	1.0- 10.0	05/25/90	2.00	0.22

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
D2117	P 21+17	13.0	U 5617.90	4	345.00	45.00	1- 1	0.0- 2.5	05/10/90	-	/ /						-	/ /		
							- 2	2.5- 10.0	05/23/90	1.0- 10.0	05/25/90	3	02	7	0.40	5.122	1.0- 10.0	05/25/90	0.80	0.09
C2117	P 21+17.5	12.5	U 5617.94	3	321.00	60.00	1- 1	0.0- 2.5	03/02/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/06/90	2.5- 29.0	03/06/90	5	0.11	7	0.02	0.134	-	/ /		
							2- 1	29.0- 87.0	03/08/90	29.0- 87.0	03/09/90	25	0.3	12	0.06	0.018	29.0- 87.0	03/12/90	1.10	0.02
							3- 1	87.0-174.0	03/22/90	15.0-174.0	03/26/90	53	6.05	7	1.21	0.099	87.0-174.0	03/27/90	111.90	1.29
A2120	T 21+20.0	15.0	U 5618.02	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	01/26/90	15.0- 29.0	01/30/90	22	01	7	0.20	0.288	15.0- 29.0	01/30/90	0.30	0.02
							- 2	-	/ /	-	/ /						5.5- 29.0	01/30/90	1.80	0.08
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	03/24/93	29	.8	7	0.16	0.044	29.0- 87.0	02/20/90	0.30	0.01
B2122	P 21+22.5	10.0	U 5618.10	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	15.0- 29.0	02/23/90	0.20	0.01
							- 2	-	/ /	-	/ /						2.5- 30.0	02/23/90	0.20	0.01
							2- 1	29.0- 87.0	02/27/90	29.0- 87.0	02/28/90	25	0.4	7	0.08	0.025	29.0- 87.0	03/02/90	0.40	0.01
A2125	P 21+25.0	15.0	U 5618.20	1	321.00	60.00	1- 1	0.0- 1.0	10/19/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	10/27/89	2.5- 29.0	01/12/90	4.	0.7	7	0.14	0.315	3.0- 29.0	01/18/90	2.00	0.08
							2- 1	29.0- 87.0	02/02/90	15.0- 87.0	02/02/90	22	2.6	7	0.52	0.139	29.0- 87.0	02/05/90	13.10	0.23
C2127	S 21+27.5	12.5	U 5618.30	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/15/90	3.0- 29.0	03/15/90	5	0.2	7	0.04	0.272	-	/ /		
							2- 1	29.0- 87.0	03/21/90	15.0- 87.0	03/21/90	26	01	7	0.20	0.055	2.5- 87.0	03/22/90	0.40	0.00
D2130	P 21+30	13.5	U 5618.50	4	321.00	45.00	1- 2	0.0- 10.0	05/23/90	1.0- 10.0	05/25/90	3	2	7	0.40	5.122	1.0- 10.0	05/25/90	1.20	0.13
A2130	T 21+30.0	15.0	U 5618.40	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	1	7	0.20	0.288	15.0- 29.0	01/30/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	01/30/90	0.40	0.02
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	03/24/93	29	.5	7	0.10	0.028	29.0- 87.0	02/20/90	0.60	0.01
B2132	S 21+32.5	10.0	U 5618.50	2	321.00	60.00	1- 1	0.0- 1.0	11/07/89	-	/ /						-	/ /		
							- 2	1.0- 29.0	02/26/90	15.0- 29.0	02/27/90	22	4	7	0.80	1.151	1.5- 29.0	02/27/90	0.20	0.01
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/02/90	25	0.8	7	0.16	0.049	29.0- 87.0	03/02/90	0.30	0.01
A2135	S 21+35.0	15.0	U 5618.60	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/22/90	10.0- 29.0	01/23/90	14	01	7	0.20	0.303	15.0- 29.0	01/23/90	0.30	0.02
							- 2	-	/ /	-	/ /						5.0- 15.0	01/23/90	0.70	0.07

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2135	S 21+35.0	15.0	U 5618.60	1	321.00	60.00	2- 1	29.0- 87.0	02/09/90	29.0- 87.0	02/12/90	25	1.5	7	0.30	0.092	29.0- 87.0	02/13/90	2.70	0.05
C2137	P 21+37.5	12.5	U 5618.80	3	321.00	60.00	1- 1	0.0- 2.5	03/02/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/06/90	2.5- 29.0	03/06/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/08/90	-	/ /						29.0- 87.0	03/12/90	11.90	0.21
							3- 1	87.0-174.0	03/23/90	15.0-174.0	03/26/90	53	6.3	7	1.26	0.103	87.0-174.0	03/27/90	123.40	1.42
A2140	T 21+40.0	15.0	U 5619.00	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	01	7	0.20	0.288	15.0- 29.0	01/30/90	2.00	0.14
							- 2	-	/ /	-	/ /						5.5- 29.0	01/30/90	0.70	0.03
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	03/24/93	29	1.4	7	0.28	0.077	29.0- 87.0	02/20/90	1.00	0.02
B2142	P 21+42.5	10.0	U 5619.00	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	15.0- 29.0	02/23/90	0.70	0.05
							- 2	-	/ /	-	/ /						2.5- 29.0	02/23/90	0.20	0.01
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	0.1	7	0.02	0.006	29.0- 87.0	03/02/90	0.50	0.01
A2145	P 21+45.0	15.0	U 5619.00	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/10/90	2.5- 29.0	01/15/90	4.0	0.2	7	0.04	0.090	3.0- 29.0	01/18/90	1.60	0.06
							2- 1	29.0- 87.0	02/02/90	15.0- 87.0	02/02/90	22	10.2	7	2.04	0.544	29.0- 87.0	02/06/90	49.10	0.85
C2147	S 21+47.5	12.5	U 5619.00	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/16/90	5	0	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/21/90	15.0- 87.0	03/21/90	26	01	7	0.20	0.055	2.5- 87.0	03/22/90	0.50	0.01
A2150	T 21+50.0	15.0	U 5619.00	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	01	7	0.20	0.288	15.0- 29.0	01/30/90	1.10	0.08
							- 2	-	/ /	-	/ /						5.5- 29.0	01/30/90	1.30	0.06
							2- 1	29.0- 87.0	02/16/90	29.0- 87.0	03/24/93	29	.2	7	0.04	0.011	29.0- 87.0	02/20/90	0.60	0.01
B2152	S 21+52.5	10.0	U 5619.00	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/26/90	15.0- 29.0	02/27/90	22	1	7	0.20	0.288	2.5- 29.0	02/27/90	0.10	0.00
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/02/90	25	0.6	7	0.12	0.037	29.0- 87.0	03/05/90	0.30	0.01
							- 1	-	/ /	29.0- 87.0	03/05/90	25	1.5	7	0.30	0.092	-	/ /		
A2155	S 21+55.0	15.0	U 5619.00	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/22/90	10.0- 29.0	01/23/90	14	9	7	1.80	2.729	15.0- 29.0	01/24/90	4.90	0.35
							- 2	-	/ /	-	/ /						3.0- 29.0	01/24/90	1.10	0.04
							2- 1	29.0- 87.0	02/09/90	29.0- 87.0	02/12/90	25	1.4	7	0.28	0.086	29.0- 87.0	02/13/90	1.00	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2157	P 21+57.5	12.5	U 5619.00	3	321.00	60.00	1- 1	0.0- 2.5	03/02/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/06/90	2.5- 29.0	03/06/90	5	0.04	7	0.01	0.067	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/09/90	25	0.01	7	0.00		29.0- 87.0	03/12/90	27.90	0.48
							3- 1	87.0-174.0	03/23/90	15.0-174.0	03/26/90	53	6.25	7	1.25	0.103	87.0-174.0	03/28/90	123.30	1.42
A2160	T 21+60.0	15.0	U 5619.00	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	2.7	7	0.54	0.777	15.0- 29.0	01/30/90	83.90	5.99
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.90	0.04
							2- 1	29.0- 87.0	02/16/90	29.0- 87.0	03/24/93	29	.7	7	0.14	0.039	29.0- 87.0	02/20/90	0.10	0.00
B2162	P 21+62.5	10.0	U 5619.00	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	9	7	1.80	1.288	2.5- 29.0	02/23/90	0.70	0.03
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	0.1	7	0.02	0.006	29.0- 87.0	03/05/90	0.50	0.01
A2165	P 21+65.0	15.0	U 5619.00	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/10/90	2.5- 29.0	01/15/90	4.0	1.0	7	0.20	0.451	3.0- 29.0	01/18/90	0.40	0.02
							2- 1	29.0- 87.0	02/02/90	29.0- 87.0	02/05/90	38.0	4.8	8	0.80	0.178	29.0- 87.0	02/06/90	41.60	0.72
D2166	P 21+66	8.0	U 5619.20	4	3.00	45.00	1- 2	0.0- 12.0	05/23/90	1.0- 12.0	05/25/90	3	01	7	0.20	2.025	1.0- 12.0	05/25/90	1.60	0.15
C2167	S 21+67.5	12.5	U 5619.20	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/16/90	5	0	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/21/90	15.0- 87.0	03/21/90	26	13	7	2.60	0.715	2.5- 87.0	03/22/90	0.50	0.01
A2170	T 21+70.0	15.0	U 5619.40	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	1.1	7	0.22	0.317	15.0- 29.0	01/31/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	01/31/90	0.40	0.02
							2- 1	29.0- 87.0	02/16/90	29.0- 87.0	03/24/93	29	.8	7	0.16	0.044	29.0- 87.0	02/20/90	0.20	0.00
B2172	S 21+72.5	10.0	U 5619.50	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/26/90	15.0- 29.0	02/27/90	22	1	7	0.20	0.288	2.5- 29.0	02/27/90	0.10	0.00
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/02/90	25	0.1	7	0.02	0.006	29.0- 87.0	03/05/90	0.20	0.00
							- 1	-	/ /	29.0- 87.0	03/05/90	25	0.9	7	0.18	0.055	-	/ /		
A2175	S 21+75.0	15.0	U 5619.70	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/22/90	10.0- 29.0	01/23/90	14	5.1	7	1.02	1.546	15.0- 29.0	01/24/90	26.20	1.87
							- 2	-	/ /	-	/ /						3.0- 29.0	01/25/90	1.30	0.05
							2- 1	29.0- 87.0	02/12/90	29.0- 87.0	02/12/90	25	3.6	7	0.72	0.221	29.0- 87.0	02/13/90	1.20	0.02
C2177	P 21+77.5	12.5	U 5619.80	3	321.00	60.00	1- 1	0.0- 2.5	03/02/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2177	P 21+77.5	12.5 U	5619.80	3	321.00	60.00	1- 2	2.5- 29.0	03/06/90	2.5- 29.0	03/06/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/09/90	-	/ /						29.0- 87.0	03/13/90	26.90	0.46
							3- 1	87.0-174.0	03/23/90	15.0-174.0	03/26/90	53	6.3	7	1.26	0.103	87.0-174.0	03/28/90	121.00	1.39
A2180	T 21+80.0	15.0 U	5619.90	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	9	7	1.80	2.590	15.0- 29.0	01/31/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	01/31/90	1.80	0.08
							2- 1	29.0- 87.0	02/16/90	29.0- 87.0	03/24/93	29	4.5	7	0.90	0.248	29.0- 87.0	02/20/90	26.50	0.46
B2182	P 21+82.5	10.0 U	5620.00	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	15.0- 29.0	02/23/90	0.90	0.06
							- 2	-	/ /	-	/ /						2.5- 29.0	02/23/90	0.20	0.01
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	1.3	7	0.26	0.080	29.0- 87.0	03/05/90	1.30	0.02
A2185	P 21+85.0	15.0 U	5620.80	1	321.00	60.00	1- 1	0.0- 2.5	01/03/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	01/10/90	2.5- 29.0	01/15/90	4.0	2.0	7	0.40	0.901	3.0- 29.0	01/18/90	2.60	0.10
							2- 1	29.0- 87.0	02/02/90	29.0- 87.0	02/05/90	38.0	10.8	7	2.16	0.481	29.0- 85.0	02/07/90	204.30	3.65
C2187	S 21+87.5	12.5 U	5621.25	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/16/90	5	01	7	0.20	1.359	-	/ /		
							2- 1	29.0- 87.0	03/21/90	15.0- 87.0	03/22/90	26	1.61	7	0.32	0.088	2.5- 87.0	03/22/90	1.50	0.02
A2190	T 21+90.0	15.0 U	5621.70	1	321.00	60.00	1- 1	0.0- 1.5	01/03/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/26/90	15.0- 29.0	01/30/90	22	2.4	7	0.48	0.691	15.0- 29.0	01/31/90	27.00	1.93
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.40	0.02
							2- 1	29.0- 87.0	02/16/90	29.0- 87.0	03/24/93	29	4.6	7	0.92	0.253	29.0- 87.0	02/20/90	12.40	0.21
B2192	S 21+92.5	10.0 U	5621.80	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	1	7	0.20	0.288	2.5- 29.0	02/27/90		
							2- 1	-	03/01/90	29.0- 87.0	03/02/90	25	5.2	7	1.04	0.320	29.0- 87.0	03/05/90	31.90	0.55
							- 1	29.0- 87.0	03/02/90	-	/ /						-	/ /		
A2195	S 21+95.0	15.0 U	5622.50	1	321.00	60.00	1- 1	0.0- 1.5	01/03/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/22/90	10.0- 29.0	01/23/90	14	1.1	7	0.22	0.334	15.0- 29.0	01/24/90	0.30	0.02
							- 2	-	/ /	-	/ /						2.0- 29.0	01/24/90	0.50	0.02
							2- 1	29.0- 87.0	02/12/90	29.0- 87.0	02/13/90	25.0	5.5	7	1.10	0.338	29.0- 87.0	02/13/90	11.80	0.20
C2197	P 21+97.5	12.5 U	5622.90	3	321.00	60.00	1- 1	0.0- 2.5	03/02/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/06/90	2.5- 29.0	03/06/90	5	0.06	7	0.01	0.067	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/09/90	25	2.5	7	0.50	0.154	29.0- 87.0	03/13/90	3.10	0.05

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2197	P 21+97.5	12.5	U 5622.90	3	321.00	60.00	3- 1	87.0-174.0	03/26/90	15.0-174.0	03/26/90	53	7.65	7	1.53	0.126	87.0-174.0	03/29/90	75.80	0.87
A2200	T 22+00.0	15.0	U 5623.30	1	321.00	60.00	1- 1	0.0- 1.5	01/03/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/30/90	22	4.5	7	0.90	1.295	15.0- 29.0	01/31/90	20.60	1.47
							- 2	-	/ /	-	/ /						5.5- 29.0	01/31/90	0.30	0.01
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	03/24/93	29	1.6	7	0.32	0.085	29.0- 87.0	02/20/90	1.50	0.03
B2202	P 22+02.5	10.0	U 5623.50	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	15.0- 29.0	02/23/90	0.20	0.01
							- 2	-	/ /	-	/ /						2.5- 29.0	02/23/90	0.40	0.02
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	0.4	7	0.08	0.024	29.0- 87.0	03/01/90	0.60	0.01
A2205	P 22+05.0	15.0	U 5625.40	1	321.00	60.00	1- 1	0.0- 1.5	01/03/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/10/90	1.5- 29.0	01/15/90	4.0	0.7	7	0.14	0.313	3.0- 29.0	01/18/90	0.40	0.02
							2- 1	29.0- 87.0	02/05/90	29.0- 87.0	02/05/90	38.0	5.5	7	1.10	0.237	29.0- 87.0	02/07/90	19.80	0.34
C2207	S 22+07.5	12.5	U 5626.45	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/16/90	5	0	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/21/90	15.0- 87.0	03/22/90	26	0.04	7	0.01	0.003	2.5- 87.0	03/22/90	1.30	0.02
A2210	T 22+10.0	15.0	U 5627.50	1	321.00	60.00	1- 1	0.0- 1.5	01/04/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/30/90	22	3.2	7	0.64	0.921	15.0- 29.0	02/01/90	2.50	0.18
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90		
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/20/90	25	01	7	0.20	0.059	29.0- 87.0	02/20/90	8.50	0.15
B2212	S 22+12.5	10.0	U 5627.80	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.5	7	0.10	0.144	1.5- 29.0	02/27/90	0.10	0.00
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/02/90	25	0.3	12	0.06	0.018	29.0- 87.0	03/05/90	0.20	0.00
A2215	S 22+15.0	15.0	U 5629.30	1	321.00	60.00	1- 1	0.0- 1.5	01/04/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/22/90	10.0- 29.0	01/23/90	14	6	7	1.20	1.819	15.0- 29.0	01/24/90	1.50	0.11
							- 2	-	/ /	-	/ /						2.0- 29.0	01/24/90	0.60	0.02
							2- 1	29.0- 87.0	02/12/90	29.0- 87.0	02/13/90	25.0	0.2	7	0.04	0.012	29.0- 87.0	02/14/90	0.20	0.00
C2217	P 22+17.5	12.5	U 5630.15	3	321.00	60.00	1- 1	0.0- 1.5	03/05/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/07/90	5.5- 29.0	03/07/90	5	05	7	1.00	7.376	-	/ /		
							2- 1	29.0- 87.0	03/09/90	-	/ /						29.0- 87.0	03/13/90	1.10	0.02
							3- 1	87.0-174.0	03/26/90	15.0-174.0	03/28/90	53	7.7	7	1.54	0.108	87.0-174.0	03/29/90	103.90	1.19
A2220	T 22+20.0	15.0	U 5631.00	1	321.00	60.00	1- 1	0.0- 1.5	01/04/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2220	T 22+20.0	15.0	U 5631.00	1	321.00	60.00	1- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/30/90	22	01	7	0.20	0.288	15.0- 29.0	02/01/90	2.00	0.14
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.70	0.03
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/20/90	25	9	7	1.80	0.529	29.0- 87.0	02/20/90	0.20	0.00
B2222	P 22+22.5	10.0	U 5632.00	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/23/90	-	/ /						15.0- 29.0	02/26/90	3.60	0.26
							- 2	-	/ /	-	/ /						1.5- 29.0	02/26/90	52.10	1.89
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	03/01/90	25	3	7	0.60	0.176	29.0- 87.0	03/01/90	0.60	0.01
A2225	P 22+25.0	15.0	U 5632.50	1	321.00	60.00	1- 1	0.0- 1.5	01/04/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/12/90	1.5- 29.0	01/15/90	4.0	2.5	7	0.50	1.116	3.0- 29.0	01/18/90	1.20	0.05
							2- 1	29.0- 87.0	02/05/90	29.0- 87.0	02/05/90	38.0	6.2	7	1.24	0.267	29.0- 87.0	02/09/90	5.90	0.10
C2227	S 22+27.5	12.5	U 5633.25	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/19/90	7.5	17	7	3.40	13.862	-	/ /		
							2- 1	29.0- 87.0	03/21/90	-	/ /						29.0- 87.0	03/22/90	21.80	0.38
A2230	T 22+30.0	15.0	U 5634.00	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/31/90	22.0	0.1	7	0.02	0.029	15.0- 29.0	02/01/90	1.80	0.13
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.40	0.02
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/20/90	25	1.6	7	0.32	0.094	29.0- 87.0	02/22/90	1.90	0.03
B2232	S 22+32.5	10.0	U 5636.00	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	1	7	0.20	0.288	1.5- 29.0	02/27/90	0.10	0.00
							2- 1	29.0- 87.0	03/02/90	-	/ /						29.0- 87.0	03/05/90		
A2235	S 22+35.0	15.0	U 5636.50	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/22/90	10.0- 29.0	01/24/90	14	01	7	0.20	0.303	15.0- 29.0	01/25/90	0.60	0.04
							- 2	-	/ /	-	/ /						2.0- 29.0	01/25/90	0.20	0.01
							2- 1	29.0- 87.0	02/12/90	29.0- 87.0	02/13/90	25.0	0.5	7	0.10	0.029	29.0- 87.0	02/14/90	0.70	0.01
C2237	P 22+37.5	12.5	U 5637.75	3	321.00	60.00	1- 1	0.0- 1.5	03/05/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/07/90	5.5- 29.0	03/07/90	5	0.04	7	0.01	0.074	-	/ /		
							2- 1	29.0- 87.0	03/09/90	-	/ /						29.0- 87.0	03/13/90	21.20	0.37
							3- 1	87.0-174.0	03/27/90	15.0-174.0	03/28/90	53	7.85	7	1.57	0.110	87.0-174.0	03/30/90	94.00	1.08
A2240	T 22+40.0	15.0	U 5639.00	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/31/90	22.0	0.2	7	0.04	0.058	15.0- 29.0	02/01/90	1.10	0.08
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.30	0.01
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/20/90	25	2.4	7	0.48	0.141	29.0- 87.0	02/22/90	0.40	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2242	P 22+42.5	10.0 U	5640.00	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	1.5- 29.0	02/26/90	0.20	0.01
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	03/01/90	25	0.1	7	0.02	0.006	29.0- 87.0	03/01/90	0.10	0.00
A2245	P 22+45.0	15.0 U	5640.60	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/12/90	1.5- 29.0	01/15/90	4.0	5.0	7	1.00	2.233	3.0- 29.0	01/18/90	8.10	0.31
							2- 1	29.0- 87.0	02/05/90	29.0- 87.0	02/06/90	25.0	1.0	7	0.20	0.059	29.0- 87.0	02/09/90	5.30	0.09
C2247	S 22+47.5	12.5 U	5641.40	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/16/90	5	0.2	7	0.04	0.272	-	/ /		
							2- 1	29.0- 87.0	03/21/90	15.0- 87.0	03/22/90	26	21	7	4.20	1.111	29.0- 87.0	03/23/90	0.50	0.01
A2250	T 22+50.0	15.0 U	5642.20	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/31/90	22.0	1.2	7	0.24	0.345	15.0- 29.0	02/01/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	1.60	0.07
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/20/90	25	1	7	0.20	0.059	29.0- 87.0	02/22/90	0.50	0.01
B2252	S 22+52.5	10.0 U	5643.00	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	3	7	0.60	0.863	1.5- 29.0	02/27/90	0.10	0.00
							2- 1	29.0- 87.0	03/02/90	-	/ /						29.0- 87.0	03/05/90		
A2255	S 22+55.0	15.0 U	5643.70	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/24/90	15.0- 29.0	01/25/90	22	01	7	0.20	0.288	15.0- 29.0	01/25/90	0.40	0.03
							- 2	-	/ /	-	/ /						2.0- 29.0	01/25/90	0.20	0.01
							2- 1	29.0- 87.0	02/13/90	29.0- 87.0	02/13/90	25.0	4.9	7	0.98	0.288	29.0- 87.0	02/14/90	26.60	0.46
C2257	P 22+57.5	12.5 U	5644.45	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	5.0- 29.0	03/19/90	7.5	01	7	0.20	0.870	-	/ /		
							2- 1	29.0- 87.0	03/20/90	-	/ /						2.5- 87.0	03/21/90	2.10	0.02
							3- 1	87.0-174.0	03/27/90	15.0-174.0	03/28/90	53	6.4	7	1.28	0.090	87.0-174.0	03/30/90	123.50	1.42
A2260	T 22+60.0	15.0 U	5645.20	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/31/90	22.0	0.1	7	0.02	0.029	15.0- 29.0	02/01/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.70	0.03
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/21/90	25	7.4	7	1.48	0.435	29.0- 87.0	02/22/90	50.30	0.87
C2261	P 22+61.0	12.5 U	5645.60	3	321.00	60.00	1- 1	0.0- 1.5	03/05/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/07/90	-	/ /						-	/ /		
							2- 1	29.0- 87.0	03/12/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2262	P 22+62.5	10.0	U 5646.00	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	2.4	7	0.48	0.343	1.5- 29.0	02/26/90	0.40	0.01
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/01/90	25	1.7	7	0.34	0.100	29.0- 87.0	03/01/90	1.60	0.03
A2265	P 22+65.0	15.0	U 5646.50	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/15/90	1.5- 29.0	01/15/90	4.0	7.4	7	1.48	3.304	3.0- 29.0	01/18/90	8.70	0.33
							- 2	-	/ /	5.0- 29.0	01/22/90	7	01	7	0.20	0.382	5.0- 29.0	01/23/90	0.60	0.03
							2- 1	29.0- 87.0	02/05/90	29.0- 87.0	02/06/90	25.0	2.5	7	0.50	0.147	29.0- 87.0	02/09/90	3.00	0.05
C2267	S 22+67.5	12.5	U 5647.20	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	3.0- 29.0	03/16/90	5	3	7	0.60	4.077	-	/ /		
A2270	T 22+70.0	15.0	U 5647.90	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	01/31/90	22.0	1.0	7	0.20	0.288	15.0- 29.0	02/02/90	0.60	0.04
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.30	0.01
							2- 1	29.0- 87.0	02/19/90	29.0- 87.0	02/21/90	25	3.0	7	0.60	0.176	29.0- 87.0	02/22/90	3.70	0.06
B2272	S 22+72.5	10.0	U 5648.50	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.1	7	0.02	0.029	1.5- 29.0	02/27/90		
							2- 1	29.0- 87.0	03/02/90	-	/ /						29.0- 87.0	03/05/90	0.30	0.01
A2275	S 22+75.0	15.0	U 5649.10	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/24/90	15.0- 29.0	01/25/90	22	9	7	1.80	2.590	15.0- 29.0	01/26/90	72.40	5.17
							- 2	-	/ /	-	/ /						6.0- 29.0	01/26/90	0.60	0.03
							2- 1	29.0- 87.0	02/13/90	29.0- 87.0	02/14/90	25	1.94	7	0.39	0.115	29.0- 87.0	02/16/90	9.50	0.16
C2277	P 22+77.5	12.5	U 5649.75	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	5.0- 29.0	03/19/90	7.5	01	7	0.20	0.870	-	/ /		
							2- 1	29.0- 87.0	03/20/90	15.0- 87.0	03/21/90	26	1.63	7	0.33	0.087	2.5- 87.0	03/21/90	0.60	0.01
							3- 1	87.0-174.0	03/27/90	15.0-174.0	03/28/90	53	6.2	7	1.24	0.087	87.0-174.0	04/02/90	1.00	0.01
A2280	T 22+80.0	15.0	U 5650.40	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	02/01/90	15	20.5	7	4.10	8.441	15.0- 29.0	02/02/90	124.30	8.88
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	1.60	0.07
							2- 1	29.0- 87.0	02/20/90	29.0- 87.0	02/21/90	25.0	2.1	10	0.42	0.123	29.0- 87.0	02/23/90	1.30	0.02
C2280	P 22+80.8	12.5	U 5650.40	3	321.00	60.00	1- 1	0.0- 1.5	03/05/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/07/90	5.5- 29.0	03/07/90	5	0.1	7	0.02	0.148	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/09/90	25	0.22	7	0.04	0.012	29.0- 87.0	03/13/90	0.60	0.01
							- 1	-	/ /	29.0- 87.0	03/12/90	25	1.1	7	0.22	0.065	-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2282	P 22+82.5	10.0	U 5651.00	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	9.5	7	1.58	1.130	15.0- 29.0	02/26/90	1.10	0.08
							- 2	-	/ /	-	/ /						1.5- 29.0	02/26/90	1.00	0.04
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/01/90	25	1	7	0.20	0.059	29.0- 87.0	03/01/90	0.20	0.00
C2282	T 22+82.5	12.5	U 5651.00	3	321.00	60.00	1- 2	0.0- 29.0	03/26/90	5.5- 29.0	03/26/90	5	01	7	0.20	1.475	-	/ /		
A2285	P 22+85.0	15.0	U 5651.70	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/15/90	1.5- 29.0	01/15/90	4.0	10.7	7	2.14	4.778	5.0- 29.0	01/19/90	0.20	0.01
							2- 1	29.0- 87.0	02/06/90	29.0- 87.0	02/06/90	25.0	7.7	7	1.54	0.453	29.0- 87.0	02/09/90	166.90	2.88
C2287	S 22+87.5	12.5	U 5652.40	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	5.0- 29.0	03/19/90	7.5	1.73	7	0.35	0.669	2.5- 29.0	03/19/90	6.80	0.26
							2- 1	29.0- 87.0	03/22/90	15.0- 87.0	03/22/90	26	18	7	3.60	0.952	29.0- 87.0	03/23/90	0.40	0.01
A2290	T 22+90.0	15.0	U 5653.10	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/30/90	15.0- 29.0	02/01/90	17	21	7	4.20	7.700	15.0- 29.0	02/02/90	165.20	11.80
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.40	0.02
							2- 1	29.0- 87.0	02/20/90	29.0- 87.0	02/21/90	25.0	2.3	7	0.46	0.135	29.0- 87.0	02/23/90	0.90	0.02
C2290	S 22+90.5	12.5	U 5653.10	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	-	/ /						-	/ /		
B2292	S 22+92.5	10.0	U 5653.80	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.6	7	0.12	0.173	1.5- 29.0	02/27/90	0.20	0.01
							2- 1	29.0- 87.0	03/02/90	-	/ /						29.0- 87.0	03/05/90		
C2292	T 22+92.5	12.5	U 5653.80	3	321.00	60.00	1- 2	0.0- 29.0	03/26/90	5.5- 29.0	03/26/90	5	01	7	0.20	1.475	-	/ /		
A2295	S 22+95.0	15.0	U 5654.40	1	321.00	60.00	1- 1	0.0- 1.5	01/09/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	01/25/90	15.0- 29.0	01/25/90	22	5.4	7	1.08	1.554	15.0- 29.0	01/26/90	39.10	2.79
							- 2	-	/ /	-	/ /						6.0- 29.0	01/26/90	1.10	0.05
							2- 1	29.0- 87.0	02/13/90	29.0- 87.0	02/14/90	25	14	7	2.80	0.823	29.0- 87.0	02/16/90	36.30	0.63
C2297	P 22+97.5	12.5	U 5655.10	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	3.0- 29.0	03/19/90	7.5	01	7	0.20	0.815	-	/ /		
							2- 1	29.0- 87.0	03/20/90	15.0- 87.0	03/21/90	26	73	7	14.60	3.862	2.5- 87.0	03/21/90	0.20	0.00
							3- 1	87.0-174.0	03/28/90	15.0-174.0	03/30/90	53	2	7	0.40	0.028	87.0-174.0	04/02/90	54.50	0.63
A2300	T 23+00.0	15.0	U 5655.80	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2300	T 23+00.0	15.0	U 5655.80	1	321.00	60.00	1- 2	5.5- 29.0	01/30/90	15.0- 29.0	02/01/90	17	19	7	3.80	6.966	15.0- 29.0	02/01/90	227.60	16.26
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	0.20	0.01
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/21/90	25.0	0.5	7	0.10	0.029	29.0- 87.0	02/22/90	1.50	0.03
B2302	P 23+02.5	10.0	U 5656.50	2	321.00	60.00	1- 1	0.0- 1.5	02/20/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1.4	7	0.28	0.200	1.5- 29.0	02/26/90	0.40	0.01
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	1.6	7	0.32	0.094	29.0- 87.0	03/01/90	1.10	0.02
C2302	P 23+02.9	12.5	U 5656.50	3	321.00	60.00	1- 1	0.0- 1.5	03/05/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/07/90	5.5- 29.0	03/07/90	5	01	7	0.20	1.475	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/09/90	25	4.0	7	0.80	0.235	29.0- 87.0	03/13/90	20.00	0.34
A2305	P 23+05.0	15.0	U 5657.80	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/15/90	5.5- 29.0	01/16/90	4.0	14.7	7	2.94	6.867	5.0- 29.0	01/19/90	68.00	2.83
							2- 1	29.0- 87.0	02/06/90	29.0- 87.0	02/06/90	25.0	8.2	7	1.64	0.482	29.0- 87.0	02/12/90	463.40	7.99
C2307	S 23+07.5	12.5	U 5658.75	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	3.0- 29.0	03/19/90	7.5	1.27	7	0.25	0.463	2.5- 87.0	03/20/90	2.50	0.03
							2- 1	29.0- 87.0	03/22/90	-	/ /						29.0- 87.0	03/23/90	1.40	0.02
A2310	T 23+10.0	15.0	U 5659.70	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/30/90	15.0- 29.0	02/01/90	17	9.9	7	1.98	3.630	15.0- 29.0	02/02/90	10.00	0.71
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	10.20	0.43
							- 2	-	/ /	-	/ /						1.5- 29.0	02/05/90	4.30	0.16
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/21/90	25.0	3.1	7	0.62	0.182	29.0- 87.0	02/22/90	4.40	0.08
C2312	S 23+12.0	12.5	U 5660.80	3	321.00	60.00	1- 1	0.0- 2.5	03/14/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/16/90	-	/ /						-	/ /		
B2312	S 23+12.5	10.0	U 5660.80	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	2.8	7	0.56	0.806	10.0- 29.0	02/27/90	2.50	0.13
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/02/90	25	5.9	7	1.18	0.347	29.0- 87.0	03/05/90	6.90	0.12
A2315	S 23+15.0	15.0	U 5661.80	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/25/90	15.0- 29.0	01/25/90	22	01	7	0.20	0.288	5.5- 34.5	01/29/90	2.30	0.08
							- 2	-	/ /	-	/ /						5.5- 19.5	01/29/90	1.40	0.10
							2- 1	29.0- 87.0	02/13/90	29.0- 87.0	02/14/90	25	18.1	7	3.62	1.064	29.0- 87.0	02/16/90	433.30	7.47
C2317	P 23+17.5	12.5	U 5662.90	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	3.0- 29.0	03/19/90	7.5	01	7	0.20	0.815	-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2317	P 23+17.5	12.5	U 5662.90	3	321.00	60.00	2- 1	29.0- 87.0	03/20/90	15.0- 87.0	03/21/90	26	26	7	5.20	1.376	2.5- 87.0	03/21/90	0.40	0.00
							3- 1	87.0-174.0	03/29/90	15.0-174.0	03/30/90	53	2.15	7	0.43	0.030	87.0-174.0	04/02/90	46.40	0.53
A2320	T 23+20.0	15.0	U 5664.00	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/30/90	15.0- 29.0	02/01/90	22	01	7	0.20	0.288	15.0- 29.0	02/01/90	1.10	0.08
							- 2	-	/ /	-	/ /						5.5- 29.0	02/01/90	1.60	0.07
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/21/90	25	1.8	7	0.36	0.106	29.0- 87.0	02/22/90	2.30	0.04
B2322	P 23+22.5	10.0	U 5665.00	2	321.00	60.00	1- 1	0.0- 2.5	02/20/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	02/23/90	15.0- 29.0	02/26/90	22	2.4	7	0.48	0.691	10.0- 29.0	02/26/90	2.30	0.12
							- 2	-	/ /	-	/ /						2.5- 29.0	02/26/90	0.40	0.02
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	2.4	7	0.48	0.141	29.0- 87.0	03/01/90	4.60	0.08
C2322	P 23+22.7	12.5	U 5665.00	3	321.00	60.00	1- 1	0.0- 2.5	03/05/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/07/90	5.5- 29.0	03/07/90	5	0.1	7	0.02	0.148	-	/ /		
							- 2	-	/ /	6.5- 29.0	03/08/90	5.	0.27	7	0.05	0.382	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/09/90	25	1.4	7	0.28	0.210	-	/ /		
A2325	P 23+25.0	15.0	U 5665.80	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/16/90	5.5- 29.0	01/16/90	4.0	6.1	7	1.22	2.849	5.0- 29.0	01/19/90	27.60	1.15
							2- 1	29.0- 87.0	02/06/90	29.0- 87.0	02/09/90	25	9.8	7	1.96	0.576	29.0- 87.0	02/12/90	177.50	3.06
A2330	T 23+30.0	15.0	U 5667.60	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/30/90	-	/ /						15.0- 29.0	02/02/90	1.10	0.08
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.40	0.02
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/21/90	25	3.0	7	0.60	0.176	29.0- 87.0	02/22/90	14.20	0.24
B2332	S 23+32.5	10.0	U 5668.50	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.2	7	0.04	0.058	10.0- 29.0	02/27/90	0.50	0.03
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/02/90	25	3.6	7	0.72	0.212	29.0- 87.0	03/05/90	9.30	0.16
A2335	S 23+35.0	15.0	U 5669.40	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/25/90	15.0- 29.0	01/25/90	22	13	7	2.60	3.742	15.0- 29.0	01/29/90	115.20	8.23
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	02/14/90	25	55	7	11.00	3.233	29.0- 87.0	02/16/90	8.80	0.15
C2337	P 23+37.5	12.5	U 5670.25	3	321.00	60.00	1- 1	0.0- 1.5	03/17/90	-	/ /						-	/ /		
							- 2	1.5- 29.0	03/19/90	3.0- 29.0	03/19/90	7.5	01	7	0.20	0.815	-	/ /		
							2- 1	29.0- 87.0	03/20/90	-	/ /						2.5- 87.0	03/21/90	0.80	0.01
							3- 1	87.0-174.0	03/29/90	15.0-174.0	03/30/90	53	2.21	7	0.44	0.031	87.0-174.0	04/03/90	43.80	0.50

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2340	T 23+40.0	15.0 U	5671.10	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/30/90	15.0- 29.0	02/02/90	22	01	7	0.20	0.288	15.0- 29.0	02/02/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.20	0.01
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	9	7	1.80	0.529	29.0- 87.0	02/22/90	1.30	0.02
B2342	P 23+42.5	10.0 U	5672.00	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/23/90	15.0- 44.0	02/23/90	21	1	7	0.20	0.143	10.0- 29.0	02/26/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	02/26/90	0.20	0.01
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	0.1	7	0.02	0.006	29.0- 87.0	03/01/90		
C2343	P 23+43.0	12.5 U	5671.75	3	321.00	60.00	1- 1	0.0- 2.5	03/05/90	-	/ /						-	/ /		
							- 2	2.5- 29.0	03/07/90	6.5- 29.0	03/08/90	5.	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/09/90	25	0.6	7	0.12	0.035	29.0- 87.0	03/12/90	0.40	0.01
							- 1	-	/ /	29.0- 87.0	03/12/90	25	1.4	7	0.28	0.082	-	/ /		
A2345	P 23+45.0	15.0 U	5672.40	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/16/90	5.5- 29.0	01/16/90	4.0	1.7	7	0.34	0.794	15.0- 24.0	01/22/90	105.90	11.77
							- 2	-	/ /	-	/ /						5.0- 29.0	01/23/90	1.90	0.08
							2- 1	29.0- 87.0	02/06/90	29.0- 87.0	02/09/90	25	1.0	7	0.20	0.059	29.0- 87.0	02/12/90	3.20	0.06
A2350	T 23+50.0	15.0 U	5673.70	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	01	7	0.20	0.288	15.0- 29.0	02/02/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.20	0.01
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	9	7	1.80	0.529	29.0- 87.0	02/22/90	1.00	0.02
B2352	S 23+52.5	10.0 U	5674.30	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.1	7	0.02	0.029	10.0- 29.0	02/27/90	0.70	0.04
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/02/90	25	0.8	7	0.16	0.047	29.0- 87.0	03/05/90	0.20	0.00
A2355	S 23+55.0	15.0 U	5674.90	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/25/90	15.0- 29.0	01/25/90	22	01	7	0.20	0.288	15.0- 29.0	01/29/90	1.30	0.09
							- 2	-	/ /	-	/ /						5.5- 29.0	01/29/90	0.20	0.01
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	02/14/90	25	18	7	3.60	1.058	29.0- 87.0	02/19/90	0.80	0.01
C2357	P 23+57.5	12.5 U	5675.45	3	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/07/90	6.5- 29.0	03/08/90	5.	0.05	7	0.01	0.076	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/12/90	25	10.6	7	2.12	0.623	29.0- 87.0	03/12/90	0.70	0.01
							3- 1	87.0-174.0	03/29/90	87.0-174.0	04/02/90	53	4	10	0.80	0.094	87.0-174.0	04/03/90	58.00	0.67
A2360	T 23+60.0	15.0 U	5676.00	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	WATER PRESSURE TEST DATA DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	GROUTING DATA DATE	TAKE (SACKS)	SACKS /FT
A2360	T 23+60.0	15.0	U 5676.00	1	321.00	60.00	1- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	01	7	0.20	0.288	15.0- 29.0	02/02/90	1.30	0.09
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	1.80	0.08
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	1	7	0.20	0.059	29.0- 87.0	02/22/90	0.70	0.01
B2362	P 23+62.5	10.0	U 5676.50	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/23/90	15.0- 29.0	02/26/90	22	01	7	0.20	0.288	5.5- 29.0	02/26/90	1.80	0.08
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	02/28/90	25	1	7	0.20	0.059	29.0- 87.0	03/01/90		
A2365	P 23+65.0	15.0	U 5677.30	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/16/90	5.5- 29.0	01/16/90	4.0	1.0	7	0.20	0.467	15.0- 29.0	01/23/90	43.20	3.09
							- 2	-	/ /	-	/ /						5.0- 20.0	01/23/90	0.40	0.03
							2- 1	29.0- 87.0	02/06/90	29.0- 87.0	02/09/90	25	2.5	7	0.50	0.147	29.0- 87.0	02/12/90	93.80	1.62
A2370	T 23+70.0	15.0	U 5678.60	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	01	7	0.20	0.288	15.0- 29.0	02/02/90	1.30	0.09
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	1.10	0.05
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	9	7	1.80	0.529	29.0- 87.0	02/22/90	0.40	0.01
B2372	S 23+72.5	10.0	U 5679.30	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.1	7	0.02	0.029	10.0- 29.0	02/27/90	2.00	0.11
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/05/90	25	2.2	7	0.44	0.129	29.0- 87.0	03/05/90	0.50	0.01
A2375	S 23+75.0	15.0	U 5679.90	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/25/90	15.0- 29.0	01/25/90	22	01	7	0.20	0.288	15.0- 29.0	01/29/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	01/29/90	0.70	0.03
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	02/16/90	25.0	0.3	7	0.06	0.018	29.0- 87.0	02/19/90	0.20	0.00
C2377	P 23+77.5	12.5	U 5680.60	3	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/08/90	5.0- 29.0	03/08/90	5	01	7	0.20	1.450	-	/ /		
							2- 1	29.0- 87.0	03/09/90	29.0- 87.0	03/12/90	25	6.90	7	1.38	0.406	29.0- 87.0	03/12/90	1.30	0.02
							3- 1	87.0-174.0	03/30/90	87.0-174.0	04/02/90	53	2	10	0.40	0.047	87.0-174.0	04/04/90	37.90	0.44
A2380	T 23+80.0	15.0	U 5681.30	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	01	7	0.20	0.288	15.0- 29.0	02/02/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.20	0.01
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	4	7	0.80	0.235	29.0- 87.0	02/22/90	0.70	0.01
B2382	P 23+82.5	10.0	U 5682.00	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/26/90	15.0- 29.0	02/26/90	22	01	7	0.20	0.288	5.5- 29.0	02/26/90	0.40	0.02
							2- 1	29.0- 87.0	02/28/90	29.0- 87.0	03/01/90	25	1.0	7	0.20	0.059	29.0- 87.0	03/01/90	0.50	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2385	P 23+85.0	15.0	U 5682.60	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/16/90	5.5- 29.0	01/16/90	4.0	0.1	7	0.02	0.047	15.0- 29.0	01/30/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	01/30/90	0.40	0.02
							2- 1	29.0- 87.0	02/07/90	29.0- 87.0	02/09/90	25	1.1	7	0.22	0.065	29.0- 87.0	02/12/90	0.50	0.01
A2390	T 23+90.0	15.0	U 5683.90	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	1	7	0.20	0.288	15.0- 29.0	02/02/90	0.30	0.02
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.20	0.01
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	1.4	7	0.28	0.082	29.0- 87.0	02/22/90	1.90	0.03
B2392	S 23+92.5	10.0	U 5684.50	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.1	7	0.02	0.029	10.0- 29.0	02/27/90	0.40	0.02
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/05/90	25	0.1	7	0.02	0.006	29.0- 87.0	03/05/90	0.20	0.00
C2392	T 23+92.5	12.5	U 5684.50	3	321.00	60.00	1- 2	0.0- 29.0	04/06/90	5.0- 29.0	04/06/90	5	01	7	0.20	1.450	-	/ /		
A2395	S 23+95.0	15.0	U 5685.10	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/25/90	15.0- 29.0	01/25/90	22	3.6	7	0.72	1.036	15.0- 29.0	01/29/90	1.80	0.13
							- 2	-	/ /	-	/ /						5.5- 29.0	01/29/90	0.90	0.04
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	02/16/90	25.0	14.1	7	2.82	0.829	29.0- 87.0	02/19/90	6.30	0.11
C2397	P 23+97.5	12.5	U 5685.75	3	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/08/90	-	/ /						-	/ /		
							2- 1	29.0- 87.0	03/13/90	29.0- 87.0	03/14/90	25	0.08	7	0.02	0.015	29.0- 87.0	03/15/90		
							3- 1	87.0-174.0	03/30/90	87.0-174.0	04/02/90	53	3.5	10	0.70	0.174	87.0-174.0	04/05/90	80.50	0.93
A2400	T 24+00.0	15.0	U 5686.40	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	2	7	0.40	0.892	15.0- 29.0	02/02/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	02/02/90	0.40	0.02
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	2	7	0.40	0.300	29.0- 87.0	02/22/90	1.60	0.03
B2402	P 24+02.5	10.0	U 5687.00	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/26/90	15.0- 29.0	02/26/90	22	09	7	1.80	4.015	5.5- 29.0	02/26/90	0.30	0.01
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/01/90	25	1.3	10	0.26	0.195	29.0- 87.0	03/01/90	0.20	0.00
C2402	T 24+02.5	12.5	U 5687.00	3	321.00	60.00	1- 2	0.0- 29.0	04/06/90	5.0- 29.0	04/06/90	5	01	7	0.20	1.450	-	/ /		
A2405	P 24+05.0	15.0	U 5687.60	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/24/90	10.0- 29.0	01/24/90	14	01	7	0.20	0.525	15.0- 29.0	01/25/90	1.80	0.13
							- 2	-	/ /	-	/ /						6.0- 29.0	01/25/90	0.40	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2405	P 24+05.0	15.0	U 5687.60	1	321.00	60.00	2- 1	29.0- 87.0	02/07/90	29.0- 87.0	02/09/90	25	0.7	7	0.14	0.105	29.0- 87.0	02/13/90	26.80	0.46
C2407	S 24+07.5	12.5	U 5688.25	3	321.00	60.00	1- 2	0.0- 29.0	04/06/90	5.0- 29.0	04/06/90	5	0.1	7	0.02	0.145	-	/ /		
A2410	T 24+10.0	15.0	U 5688.90	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	3.4	7	0.68	1.517	5.5- 29.0	02/05/90	1.90	0.08
							2- 1	29.0- 87.0	02/21/90	29.0- 87.0	02/22/90	25	3.2	7	0.64	0.480	29.0- 87.0	02/23/90	20.20	0.35
B2412	S 24+12.5	10.0	U 5689.50	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/27/90	15.0- 29.0	02/27/90	22	0.9	7	0.18	0.402	7.0- 26.0	02/27/90	0.60	0.03
							2- 1	29.0- 87.0	03/02/90	29.0- 87.0	03/05/90	25	0.2	7	0.04	0.030	29.0- 87.0	03/05/90		
C2412	T 24+12.5	12.5	U 5689.50	3	321.00	60.00	1- 2	0.0- 29.0	04/06/90	5.0- 29.0	04/06/90	5	01	7	0.20	1.450	-	/ /		
A2415	S 24+15.0	15.0	U 5690.10	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/26/90	15.0- 29.0	01/26/90	22	2	7	0.40	0.892	15.0- 29.0	01/29/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	01/29/90	0.20	0.01
							2- 1	29.0- 87.0	02/14/90	29.0- 87.0	02/16/90	25.0	0.1	7	0.02	0.015	29.0- 87.0	02/19/90		
C2417	P 24+17.5	12.5	U 5690.75	3	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/08/90	5.0- 29.0	03/08/90	5.0	0.14	7	0.03	0.217	87.0-174.0	04/05/90	0.20	0.00
							2- 1	29.0- 87.0	03/12/90	29.0- 87.0	03/12/90	25	7.5	7	1.50	1.126	29.0- 87.0	03/12/90	3.10	0.05
							3- 1	87.0-174.0	03/30/90	-	/ /						87.0-174.0	04/04/90	70.50	0.81
A2420	T 24+20.0	15.0	U 5691.40	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/31/90	15.0- 29.0	02/02/90	22	1	7	0.20	0.288	5.5- 29.0	02/05/90	1.80	0.08
							2- 1	29.0- 87.0	02/22/90	29.0- 87.0	02/22/90	25	8.3	7	1.66	0.691	29.0- 87.0	02/23/90	35.70	0.62
B2422	P 24+22.5	10.0	U 5692.00	2	321.00	60.00	1- 1	0.0- 5.5	02/20/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	02/26/90	15.0- 29.0	02/26/90	22	01	7	0.20	0.288	5.5- 29.0	02/26/90	1.80	0.08
							2- 1	29.0- 87.0	03/01/90	29.0- 87.0	03/01/90	25	3.9	7	0.78	0.325	29.0- 87.0	03/01/90	0.10	0.00
A2425	P 24+25.0	15.0	U 5692.90	1	321.00	60.00	1- 1	0.0- 5.5	01/09/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	01/24/90	10.0- 29.0	01/24/90	14	01	7	0.20	0.303	15.0- 29.0	01/25/90	0.40	0.03
							- 2	-	/ /	-	/ /						6.0- 29.0	01/25/90	0.20	0.01
							2- 1	29.0- 87.0	02/07/90	29.0- 87.0	02/12/90	25	6.4	7	1.28	0.533	29.0- 87.0	02/13/90	83.50	1.44
A2430	T 24+30.0	15.0	U 5694.30	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	0.40	0.02
							2- 1	29.0- 87.0	04/12/90	29.0- 87.0	04/16/90	25	1.5	7	0.30	0.125	29.0- 87.0	04/17/90	6.10	0.11

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2432	S 24+32.5	10.0	U 5695.00	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/01/90	0.40	0.02
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							2- 1	29.0- 87.0	05/08/90	29.0- 87.0	05/09/90	25	1.1	7	0.22	0.092	29.0- 87.0	05/10/90	3.20	0.06
A2435	S 24+35.0	15.0	U 5695.80	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/22/90	5	14.0	7	2.80	6.540	5.5- 29.0	03/22/90	82.90	3.53
							2- 1	29.0- 87.0	04/06/90	29.0- 87.0	04/09/90	25	7.05	7	1.41	0.587	29.0- 87.0	04/09/90	75.70	1.31
C2437	P 24+37.5	12.5	U 5696.55	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/17/90	6.0- 87.0	05/18/90	25	8	7	1.60	0.427	6.0- 87.0	05/18/90	20.20	0.25
							3- 1	87.0-174.0	05/23/90	87.0-174.0	05/25/90	53	0.01	7	0.00		87.0-174.0	05/25/90	0.20	0.00
A2440	T 24+40.0	15.0	U 5697.30	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	1.00	0.04
							2- 1	29.0- 87.0	04/12/90	29.0- 87.0	04/16/90	25	11.5	7	2.30	0.957	29.0- 87.0	04/17/90	61.80	1.07
B2442	P 24+42.5	10.0	U 5698.00	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	5.5- 29.0	04/27/90	0.40	0.02
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	25	0.8	7	0.16	0.067	29.0- 87.0	05/03/90	1.30	0.02
A2445	P 24+45.0	15.0	U 5698.70	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	1	16.32	8	3.26	11.143	5.5- 29.0	03/16/90	25.20	1.07
							2- 1	29.0- 87.0	03/30/90	29.0- 87.0	04/02/90	25.0	10.2	7	2.04	0.849	29.0- 87.0	04/03/90	45.10	0.78
A2450	T 24+50.0	15.0	U 5699.90	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	0.50	0.02
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/16/90	25	0.5	7	0.10	0.042	29.0- 87.0	04/17/90	0.60	0.01
B2452	S 24+52.5	10.0	U 5700.50	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/01/90	0.20	0.01
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							2- 1	29.0- 87.0	05/08/90	29.0- 87.0	05/09/90	25	0.4	7	0.08	0.033	29.0- 87.0	05/10/90	0.60	0.01
A2455	S 24+55.0	15.0	U 5701.10	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/21/90	5.5- 29.0	03/22/90	5	17.6	7	3.52	8.221	5.5- 29.0	03/23/90	42.40	1.80
							2- 1	29.0- 87.0	04/06/90	29.0- 87.0	04/09/90	25	4.75	7	0.95	0.395	29.0- 87.0	04/09/90	90.60	1.56

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2457	P 24+57.5	12.5	U 5701.70	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/17/90	6.0- 87.0	05/18/90	25	1.4	7	0.28	0.075	6.0- 87.0	05/18/90	1.10	0.01
							3- 1	87.0-174.0	05/23/90	87.0-174.0	05/25/90	53	3.1	7	0.62	0.088	87.0-174.0	05/25/90	14.80	0.17
A2460	T 24+60.0	15.0	U 5702.30	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	0.50	0.02
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/16/90	25	1.7	7	0.34	0.141	29.0- 87.0	04/17/90	0.60	0.01
B2462	P 24+62.5	10.0	U 5703.00	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	5.5- 29.0	04/27/90	0.40	0.02
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	25	1.7	7	0.34	0.141	29.0- 87.0	05/03/90	1.90	0.03
A2465	P 24+65.0	15.0	U 5703.60	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	8.95	7	1.79	4.181	5.5- 29.0	03/16/90	33.20	1.41
							2- 1	29.0- 87.0	03/30/90	29.0- 87.0	04/02/90	25	19.5	7	3.90	1.623	29.0- 87.0	04/03/90	83.40	1.44
A2470	T 24+70.0	15.0	U 5705.00	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	0.10	0.00
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/16/90	25	2.1	10	0.30	0.125	29.0- 87.0	04/18/90	0.20	0.00
B2472	S 24+72.5	10.0	U 5705.70	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/01/90		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							2- 1	29.0- 87.0	05/08/90	29.0- 87.0	05/09/90	25	1.1	7	0.22	0.092	29.0- 87.0	05/10/90	0.80	0.01
A2475	S 24+75.0	15.0	U 5706.40	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/21/90	5.5- 29.0	03/22/90	5	0.01	7	0.00		5.5- 29.0	03/23/90	0.20	0.01
							2- 1	29.0- 87.0	04/06/90	29.0- 87.0	04/09/90	25	8.65	7	1.73	0.720	29.0- 87.0	04/09/90	66.20	1.14
C2477	P 24+77.5	12.5	U 5707.10	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/17/90	6.0- 87.0	05/18/90	25	1.2	7	0.24	0.064	6.0- 87.0	05/18/90	1.60	0.02
							3- 1	87.0-174.0	05/23/90	87.0-174.0	05/25/90	53	9.5	7	1.90	0.270	87.0-174.0	05/29/90	17.20	0.20
A2480	T 24+80.0	15.0	U 5707.80	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	0.10	0.00
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/16/90	25	2.8	7	0.56	0.233	29.0- 87.0	04/18/90	1.30	0.02

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2482	P 24+82.5	10.0	U 5708.45	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	5.5- 29.0	04/27/90	0.20	0.01
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	25	1.0	7	0.20	0.083	29.0- 87.0	05/03/90	0.40	0.01
A2485	P 24+85.0	15.0	U 5709.10	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	6.69	7	1.34	3.130	5.5- 29.0	03/19/90	29.40	1.25
							2- 1	29.0- 87.0	03/30/90	29.0- 87.0	04/02/90	25	0.2	7	0.04	0.017	29.0- 87.0	04/03/90	0.20	0.00
A2490	T 24+90.0	15.0	U 5710.60	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/26/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90	0.10	0.00
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/16/90	25	2.3	7	0.46	0.191	29.0- 87.0	04/18/90	0.30	0.01
B2492	S 24+92.5	10.0	U 5711.40	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/02/90	0.10	0.00
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.1	7	0.02	0.047	-	/ /		
							2- 1	29.0- 87.0	05/08/90	29.0- 87.0	05/09/90	25	0.7	7	0.14	0.058	29.0- 87.0	05/10/90		
A2495	S 24+95.0	15.0	U 5712.20	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	06	7	1.20	2.803	5.5- 29.0	03/23/90	2.00	0.09
							2- 1	29.0- 87.0	04/05/90	29.0- 87.0	04/09/90	25	9	7	1.80	0.749	29.0- 87.0	04/10/90	0.80	0.01
C2497	P 24+97.5	12.5	U 5712.95	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/17/90	6.0- 87.0	05/18/90	25	2	7	0.40	0.107	29.0- 87.0	05/21/90	0.10	0.00
							3- 1	87.0-174.0	05/23/90	87.0-174.0	05/25/90	53	1.0	7	0.20	0.028	87.0-174.0	05/29/90	0.20	0.00
A2500	T 25+00.0	15.0	U 5713.70	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/28/90		
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/18/90	25	0.3	7	0.06	0.019	29.0- 87.0	04/18/90	0.10	0.00
B2502	P 25+02.5	9.9	U 5714.50	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	5.5- 29.0	04/27/90	0.10	0.00
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	25	0.3	7	0.06	0.019	29.0- 87.0	05/03/90	0.20	0.00
A2505	P 25+05.0	14.9	U 5715.30	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	0	7	0.00		5.5- 29.0	03/19/90	0.20	0.01
							2- 1	29.0- 87.0	03/30/90	29.0- 87.0	04/02/90	25	1.0	7	0.20	0.063	29.0- 87.0	04/03/90		
A2510	T 25+10.0	14.8	U 5717.00	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2510	T 25+10.0	14.8	U 5717.00	1	321.00	60.00	1- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90	0.20	0.01
							2- 1	29.0- 87.0	04/16/90	29.0- 87.0	04/18/90	25	0.7	7	0.14	0.044	29.0- 87.0	04/18/90	0.10	0.00
B2512	S 25+12.5	9.7	U 5717.85	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.6	7	0.12	0.280	5.5- 29.0	05/02/90	0.20	0.01
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.6	7	0.12	0.280	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.6	7	0.12	0.280	-	/ /		
							2- 1	29.0- 87.0	05/09/90	29.0- 87.0	05/09/90	25	0.3	7	0.06	0.019	29.0- 87.0	05/10/90	0.60	0.01
A2515	S 25+15.0	14.7	U 5718.70	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/21/90	5.5- 29.0	03/23/90	5	3.48	7	0.70	1.635	5.5- 29.0	03/23/90	19.30	0.82
							2- 1	29.0- 87.0	04/05/90	29.0- 87.0	04/09/90	25	5.35	7	1.07	0.337	29.0- 87.0	04/10/90	12.10	0.21
C2517	P 25+17.5	12.1	U 5719.55	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/17/90	6.0- 87.0	05/18/90	25	6	7	1.20	0.320	29.0- 87.0	05/21/90	0.20	0.00
							3- 1	87.0-174.0	05/23/90	87.0-174.0	05/25/90	53	5.7	7	1.14	0.162	87.0-174.0	05/29/90	4.30	0.05
A2520	T 25+20.0	14.6	U 5720.40	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90	0.10	0.00
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	9.9	7	1.98	0.623	29.0- 87.0	04/18/90	4.20	0.07
B2522	P 25+22.5	9.5	U 5721.20	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	03	7	0.60	1.401	5.5- 29.0	04/27/90	0.40	0.02
							2- 1	29.0- 87.0	05/02/90	29.0- 87.0	05/03/90	25	0.8	7	0.16	0.050	29.0- 87.0	05/04/90	5.10	0.09
A2525	P 25+25.0	14.5	U 5722.00	1	321.00	60.00	1- 1	0.0- 5.5	03/05/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	3.71	7	0.74	1.728	5.5- 29.0	03/19/90	1.30	0.06
							2- 1	29.0- 87.0	03/30/90	29.0- 87.0	04/02/90	25	20.8	7	4.16	1.309	29.0- 87.0	04/03/90	41.60	0.72
A2530	T 25+30.0	14.3	U 5723.40	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90		
							2- 1	29.0- 87.0	04/17/90	-	/ /						29.0- 87.0	04/18/90	0.30	0.01
B2532	S 25+32.5	9.3	U 5724.10	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.2	7	0.04	0.093	5.5- 29.0	05/02/90	0.20	0.01
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.2	7	0.04	0.093	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.2	7	0.04	0.093	-	/ /		
							2- 1	29.0- 87.0	05/09/90	29.0- 87.0	05/09/90	25	1.2	7	0.24	0.076	29.0- 87.0	05/11/90	6.90	0.12

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2535	S 25+35.0	14.2	U 5724.80	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/21/90	5.5- 29.0	03/23/90	5	15	7	3.00	7.007	5.5- 29.0	03/23/90	0.40	0.02
							2- 1	29.0- 87.0	04/05/90	29.0- 87.0	04/09/90	25	2.7	7	0.54	0.170	29.0- 87.0	04/10/90	3.40	0.06
C2537	P 25+37.5	11.7	U 5725.50	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/17/90	6.0- 87.0	05/18/90	25	4	7	0.80	0.213	29.0- 87.0	05/21/90		
							3- 1	87.0-174.0	05/23/90	87.0-174.0	05/25/90	53	0.5	15	0.10	0.014	87.0-174.0	05/29/90	0.40	0.00
A2540	T 25+40.0	14.1	U 5726.20	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90	0.30	0.01
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	0.4	7	0.08	0.025	29.0- 87.0	04/18/90	0.20	0.00
B2542	P 25+42.5	9.1	U 5726.95	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1.82	7	0.36	0.841	5.5- 29.0	04/27/90	10.20	0.43
							2- 1	29.0- 87.0	05/03/90	29.0- 87.0	05/03/90	25	1.7	7	0.34	0.107	29.0- 87.0	05/04/90	7.70	0.13
A2545	P 25+45.0	14.0	U 5727.70	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	3.81	7	0.76	1.775	5.5- 29.0	03/19/90	1.20	0.05
							2- 1	29.0- 87.0	04/02/90	29.0- 87.0	04/02/90	25	18.1	7	3.62	1.139	29.0- 87.0	04/04/90	71.90	1.24
A2550	T 25+50.0	13.9	U 5729.50	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.4	7	0.08	0.187	5.5- 29.0	03/29/90	0.40	0.02
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	3.6	7	0.72	0.227	29.0- 87.0	04/18/90	0.80	0.01
B2552	S 25+52.5	8.8	U 5730.40	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	4.5	7	0.90	2.102	5.5- 29.0	05/02/90	4.60	0.20
							- 2	-	/ /	5.5- 29.0	05/01/90	5	4.5	7	0.90	2.102	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	4.5	7	0.90	2.102	-	/ /		
							2- 1	29.0- 87.0	05/09/90	29.0- 87.0	05/09/90	25	0.3	7	0.06	0.019	29.0- 87.0	05/11/90	0.60	0.01
A2555	S 25+55.0	13.8	U 5731.30	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/21/90	5.5- 29.0	03/23/90	5	11.7	7	2.34	5.465	5.5- 29.0	03/26/90	57.60	2.45
							2- 1	29.0- 87.0	04/05/90	29.0- 87.0	04/10/90	25	55	7	11.00	3.461	29.0- 87.0	04/10/90	2.20	0.04
C2557	P 25+57.5	11.2	U 5732.20	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	0.01	7	0.00		29.0- 87.0	05/21/90	0.40	0.01
							3- 1	87.0-174.0	05/24/90	87.0-174.0	05/25/90	53	5.7	7	1.14	0.162	87.0-174.0	05/29/90	25.20	0.29

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2560	T 25+60.0	13.7	U 5733.10	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90	0.20	0.01
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	0.1	15	0.02	0.006	29.0- 87.0	04/20/90	1.70	0.03
B2562	P 25+62.5	8.6	U 5733.95	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	0.1	7	0.02	0.047	5.5- 29.0	04/27/90		
							2- 1	29.0- 87.0	05/03/90	29.0- 87.0	05/03/90	25	0.4	7	0.08	0.025	29.0- 87.0	05/04/90	0.70	0.01
A2565	P 25+65.0	13.6	U 5734.80	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	0	7	0.00		5.5- 29.0	03/19/90	0.20	0.01
							2- 1	29.0- 87.0	04/02/90	29.0- 87.0	04/02/90	25	17.2	7	3.44	1.082	29.0- 87.0	04/04/90	1.40	0.02
A2570	T 25+70.0	13.5	U 5736.60	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90		
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	24.9	15	4.98	1.567	29.0- 87.0	04/20/90	26.50	0.46
B2572	S 25+72.5	8.4	U 5737.50	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	5.2	7	1.04	2.429	5.5- 29.0	05/02/90	0.60	0.03
							- 2	-	/ /	5.5- 29.0	05/01/90	5	5.2	7	1.04	2.429	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	5.2	7	1.04	2.429	-	/ /		
							2- 1	29.0- 87.0	05/09/90	29.0- 87.0	05/10/90	25.0	13.8	7	2.76	0.868	29.0- 87.0	05/11/90	37.80	0.65
A2575	S 25+75.0	13.4	U 5738.40	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	1	7	0.20	0.467	5.5- 29.0	03/26/90	0.50	0.02
							2- 1	29.0- 87.0	04/09/90	29.0- 87.0	04/10/90	25	4.75	7	0.95	0.299	29.0- 87.0	04/10/90	20.30	0.35
C2577	P 25+77.5	10.8	U 5739.30	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	0.6	7	0.12	0.038	29.0- 87.0	05/21/90	0.40	0.01
							3- 1	87.0-174.0	05/24/90	87.0-174.0	05/25/90	53	0.8	7	0.16	0.023	87.0-174.0	05/30/90	1.30	0.01
A2580	T 25+80.0	13.2	U 5740.20	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.01	7	0.00		5.5- 29.0	03/29/90	0.30	0.01
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	2.4	7	0.48	0.151	29.0- 87.0	04/20/90	4.40	0.08
B2582	P 25+82.5	8.2	U 5741.15	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	0.1	7	0.02	0.047	15.0- 29.0	04/30/90	1.10	0.08
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	0.10	0.00
							2- 1	29.0- 87.0	05/03/90	29.0- 87.0	05/03/90	25	1.0	7	0.20	0.063	29.0- 87.0	05/04/90	1.50	0.03

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2585	P 25+85.0	13.1	U 5742.10	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/12/90	5.5- 29.0	03/15/90	5	8.16	10	1.63	3.807	5.5- 29.0	03/20/90	84.50	3.60
							2- 1	29.0- 87.0	04/02/90	29.0- 87.0	04/02/90	25	3.1	7	0.62	0.195	29.0- 87.0	04/04/90	0.30	0.01
A2590	T 25+90.0	13.0	U 5743.80	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.3	7	0.06	0.140	5.5- 29.0	03/29/90	1.80	0.08
							2- 1	29.0- 87.0	04/17/90	29.0- 87.0	04/18/90	25	1.4	7	0.28	0.088	29.0- 87.0	04/20/90	0.60	0.01
B2592	S 25+92.5	8.0	U 5744.65	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	1.1	7	0.22	0.514	5.5- 29.0	05/02/90	0.30	0.01
							- 2	-	/ /	5.5- 29.0	05/01/90	5	1.1	7	0.22	0.514	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	1.1	7	0.22	0.514	-	/ /		
							2- 1	29.0- 87.0	05/09/90	29.0- 87.0	05/11/90	25	8.8	7	1.76	0.554	29.0- 87.0	05/14/90	16.10	0.28
A2595	S 25+95.0	12.9	U 5745.50	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	4.5	7	0.90	2.102	5.5- 29.0	03/26/90	41.10	1.75
							2- 1	29.0- 87.0	04/09/90	29.0- 87.0	04/10/90	25	3.35	7	0.67	0.211	29.0- 87.0	04/11/90	22.90	0.39
C2597	P 25+97.5	10.4	U 5746.35	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	0.2	7	0.04	0.013	29.0- 87.0	05/21/90	0.20	0.00
							3- 1	87.0-174.0	05/24/90	87.0-174.0	05/30/90	53.0	6.0	7	1.20	0.171	87.0-174.0	05/30/90	0.40	0.00
A2600	T 26+00.0	12.8	U 5747.20	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.4	7	0.08	0.187	5.5- 29.0	03/29/90	0.40	0.02
							2- 1	29.0- 87.0	04/18/90	29.0- 87.0	04/18/90	25	2.8	7	0.56	0.176	29.0- 87.0	04/20/90	1.20	0.02
B2602	P 26+02.5	7.7	U 5748.05	2	321.00	60.00	1- 1	0.0- 5.5	04/23/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	0.1	7	0.02	0.047	15.0- 29.0	04/30/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	0.20	0.01
							2- 1	29.0- 87.0	05/03/90	29.0- 87.0	05/04/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/07/90	65.30	1.13
A2605	P 26+05.0	12.7	U 5748.90	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/13/90	5.5- 29.0	03/15/90	5	6.2	7	1.24	2.896	5.5- 29.0	03/20/90	46.50	1.98
							2- 1	29.0- 87.0	04/02/90	29.0- 87.0	04/02/90	25	3.1	7	0.62	0.195	29.0- 87.0	04/04/90	0.20	0.00
A2610	T 26+10.0	12.6	U 5750.60	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/28/90	5	0.2	7	0.04	0.093	5.5- 29.0	03/30/90	0.50	0.02
							2- 1	29.0- 87.0	04/18/90	29.0- 87.0	04/18/90	25	2.1	7	0.42	0.132	29.0- 87.0	04/20/90	5.40	0.09

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2612	S 26+12.5	7.5	U 5751.45	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/30/90	5.5- 29.0	05/01/90	5	0.2	7	0.04	0.093	5.5- 29.0	05/02/90	0.10	0.00
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.2	7	0.04	0.093	-	/ /		
							- 2	-	/ /	5.5- 29.0	05/01/90	5	0.2	7	0.04	0.093	-	/ /		
							2- 1	29.0- 87.0	05/10/90	29.0- 87.0	05/11/90	25	11.5	7	2.30	0.724	29.0- 87.0	05/14/90	6.20	0.11
A2615	S 26+15.0	12.5	U 5752.30	1	321.00	60.00	1- 1	0.0- 5.5	03/06/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	11	7	2.20	5.138	5.5- 29.0	03/26/90	0.20	0.01
							2- 1	29.0- 87.0	04/09/90	29.0- 87.0	04/10/90	25	05	7	1.00	0.315	29.0- 87.0	04/11/90	0.10	0.00
C2617	P 26+17.5	9.9	U 5753.15	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/21/90	0.10	0.00
							3- 1	87.0-174.0	05/25/90	87.0-174.0	05/30/90	53	0.2	7	0.04	0.006	87.0-174.0	05/30/90	0.20	0.00
A2620	T 26+20.0	12.4	U 5754.00	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/27/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90		
							2- 1	29.0- 87.0	04/18/90	29.0- 87.0	04/19/90	25	1	15	0.20	0.063	29.0- 87.0	04/20/90		
B2622	P 26+22.5	7.3	U 5754.80	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	15.0- 29.0	04/30/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	14.20	0.60
							2- 1	29.0- 87.0	05/03/90	29.0- 87.0	05/04/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/07/90	0.10	0.00
A2625	P 26+25.0	12.3	U 5755.60	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/13/90	5.5- 29.0	03/15/90	5	0.08	7	0.02	0.047	5.5- 34.5	03/21/90	0.10	0.00
							2- 1	29.0- 87.0	04/02/90	29.0- 87.0	04/02/90	25	0.1	7	0.02	0.006	29.0- 87.0	04/04/90	0.10	0.00
A2630	T 26+30.0	12.1	U 5757.20	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90		
							2- 1	29.0- 87.0	04/18/90	-	/ /						29.0- 87.0	04/20/90	1.20	0.02
B2632	S 26+32.5	7.1	U 5758.00	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	-	/ /						5.5- 29.0	05/02/90	0.10	0.00
							2- 1	29.0- 87.0	05/10/90	29.0- 87.0	05/11/90	25	7.5	17	1.50	0.472	29.0- 87.0	05/14/90	1.60	0.03
A2635	S 26+35.0	12.0	U 5758.80	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	01	7	0.20	0.467	5.5- 29.0	03/27/90	0.10	0.00
							2- 1	29.0- 87.0	04/09/90	29.0- 87.0	04/10/90	25	0.19	7	0.04	0.013	29.0- 87.0	04/11/90	0.10	0.00

Table 6 (Continued)

								DRILLING DATA		WATER PRESSURE TEST DATA							GROUTING DATA			
HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DEPTH (FT)	DATE COMPLETED	DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2637	P 26+37.5	9.5	U 5759.60	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	0.3	7	0.06	0.019	29.0- 87.0	05/21/90	0.20	0.00
							3- 1	87.0-174.0	05/25/90	87.0-174.0	05/30/90	53	0.6	21	0.12	0.017	87.0-174.0	05/30/90	0.30	0.00
A2640	T 26+40.0	11.9	U 5760.40	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90		
							2- 1	29.0- 87.0	04/18/90	29.0- 87.0	04/19/90	25	1.4	7	0.28	0.088	29.0- 87.0	04/23/90	35.00	0.60
B2642	P 26+42.5	6.9	U 5761.20	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	15.0- 29.0	04/30/90	0.90	0.06
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	0.40	0.02
							2- 1	29.0- 87.0	05/03/90	29.0- 87.0	05/04/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/07/90	0.10	0.00
A2645	P 26+45.0	11.8	U 5762.00	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/13/90	5.5- 29.0	03/15/90	5	0.01	7	0.00		5.5- 29.0	03/21/90	0.10	0.00
							2- 1	29.0- 87.0	04/02/90	29.0- 87.0	04/04/90	25	0.1	7	0.02	0.006	29.0- 87.0	04/04/90	0.20	0.00
A2650	T 26+50.0	11.7	U 5763.60	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90		
							2- 1	29.0- 87.0	04/19/90	-	/ /						29.0- 87.0	04/20/90	4.00	0.07
B2652	S 26+52.5	6.6	U 5764.40	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/02/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/02/90		
							2- 1	29.0- 87.0	05/10/90	29.0- 87.0	05/11/90	25	4.8	7	0.96	0.302	29.0- 87.0	05/15/90	3.20	0.06
A2655	S 26+55.0	11.6	U 5765.20	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	01	7	0.20	0.467	5.5- 29.0	03/27/90	0.20	0.01
							2- 1	29.0- 87.0	04/10/90	29.0- 87.0	04/10/90	25	72	14	14.40	4.531	29.0- 87.0	04/12/90	0.40	0.01
C2657	P 26+57.5	9.0	U 5766.00	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	0.4	7	0.08	0.025	29.0- 87.0	05/22/90	0.30	0.01
							3- 1	87.0-174.0	05/25/90	87.0-174.0	05/30/90	53	0.7	7	0.14	0.020	87.0-174.0	05/30/90	0.30	0.00
A2660	T 26+60.0	11.5	U 5766.80	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90	0.40	0.02
							2- 1	29.0- 87.0	04/19/90	29.0- 87.0	04/19/90	25	1.1	15	0.22	0.069	29.0- 87.0	04/23/90	0.20	0.00
B2662	P 26+62.5	6.4	U 5767.60	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		

Table 6 (Continued)

								DRILLING DATA		WATER PRESSURE TEST DATA							GROUTING DATA			
HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DEPTH (FT)	DATE COMPLETED	DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2662	P 26+62.5	6.4	U 5767.60	2	321.00	60.00	1- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	15.0- 29.0	04/30/90	24.10	1.72
							- 2	-	/ /	-	/ /						5.5- 29.0	05/01/90	0.10	0.00
							2- 1	29.0- 87.0	05/04/90	29.0- 87.0	05/07/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/07/90	54.50	0.94
A2665	P 26+65.0	11.4	U 5768.40	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/13/90	5.5- 29.0	03/15/90	5	3.1	7	0.62	1.448	5.5- 29.0	03/21/90	5.90	0.25
							2- 1	29.0- 87.0	04/03/90	29.0- 87.0	04/04/90	25	3.2	7	0.64	0.201	29.0- 87.0	04/04/90	2.30	0.04
A2670	T 26+70.0	11.3	U 5766.60	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90	55.40	2.36
							2- 1	29.0- 87.0	04/19/90	29.0- 87.0	04/19/90	25	2.6	7	0.52	0.164	29.0- 87.0	04/23/90	0.20	0.00
B2672	S 26+72.5	6.2	U 5769.25	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/02/90	5	0.8	7	0.16	0.374	5.5- 29.0	05/02/90	0.40	0.02
							2- 1	29.0- 87.0	05/10/90	-	/ /						29.0- 87.0	05/14/90	1.10	0.02
A2675	S 26+75.0	11.2	U 5771.90	1	321.00	60.00	1- 1	0.0- 5.5	03/08/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	1.44	7	0.29	0.677	5.5- 29.0	03/27/90	18.60	0.79
							2- 1	29.0- 87.0	04/10/90	29.0- 87.0	04/12/90	25	4.5	7	0.90	0.283	29.0- 87.0	04/12/90	2.70	0.05
C2677	P 26+77.5	8.6	U 5772.80	3	321.00	60.00	1- 1	0.0- 5.5	05/14/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/16/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/18/90	29.0- 87.0	05/21/90	25	1.2	7	0.24	0.076	29.0- 87.0	05/22/90	1.10	0.02
							3- 1	87.0-174.0	05/29/90	-	/ /						87.0-174.0	05/30/90	0.60	0.01
A2680	T 26+80.0	11.0	U 5773.70	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	-	/ /						5.5- 29.0	03/30/90	0.40	0.02
							2- 1	29.0- 87.0	04/19/90	29.0- 87.0	04/23/90	25	2.8	7	0.56	0.176	29.0- 87.0	04/23/90	1.50	0.03
B2682	P 26+82.5	6.0	U 5774.60	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/26/90	5.5- 29.0	04/27/90	5	1	7	0.20	0.467	15.0- 29.0	04/30/90	0.40	0.03
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	0.40	0.02
							2- 1	29.0- 87.0	05/04/90	29.0- 87.0	05/07/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/07/90	6.00	0.10
A2685	P 26+85.0	10.9	U 5775.50	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/13/90	5.5- 29.0	03/15/90	5	12.5	7	2.50	5.839	5.5- 29.0	03/21/90	47.00	2.00
							2- 1	29.0- 87.0	04/03/90	29.0- 87.0	04/04/90	25	1.1	7	0.22	0.069	29.0- 87.0	04/04/90	0.50	0.01
A2690	T 26+90.0	10.8	U 5777.00	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90	0.30	0.01

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
A2690	T 26+90.0	10.8	U 5777.00	1	321.00	60.00	2- 1	29.0- 87.0	04/19/90	29.0- 87.0	04/23/90	25	0.2	7	0.04	0.013	29.0- 87.0	04/23/90	0.10	0.00
B2692	S 26+92.5	5.8	U 5777.80	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/02/90	5	1.0	7	0.20	0.467	5.5- 29.0	05/03/90	0.20	0.01
							2- 1	29.0- 87.0	05/10/90	29.0- 87.0	05/14/90	25	3.2	7	0.64	0.201	29.0- 87.0	05/14/90	31.90	0.55
A2695	S 26+95.0	10.7	U 5778.60	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	17	7	3.40	7.941	5.5- 29.0	03/27/90	0.10	0.00
							2- 1	29.0- 87.0	04/10/90	29.0- 87.0	04/12/90	25	0.3	12	0.03	0.009	29.0- 87.0	04/16/90	9.80	0.17
C2697	P 26+97.5	8.2	U 5779.40	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/17/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/21/90	25	1.3	7	0.26	0.082	29.0- 87.0	05/22/90	0.30	0.01
							3- 1	87.0-174.0	05/29/90	87.0-174.0	05/30/90	53	0.5	7	0.10	0.014	87.0-174.0	05/30/90	0.40	0.00
A2700	T 27+00.0	10.6	U 5780.20	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/28/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90	0.10	0.00
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	0.1	7	0.02	0.006	29.0- 87.0	04/23/90	0.10	0.00
B2702	P 27+02.5	5.5	U 5781.00	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/27/90	5.5- 29.0	04/30/90	5	01	7	0.20	0.467	15.0- 29.0	04/30/90	0.20	0.01
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	0.40	0.02
							2- 1	29.0- 87.0	05/04/90	29.0- 87.0	05/07/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/08/90	0.40	0.01
A2705	P 27+05.0	10.5	U 5781.80	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/14/90	5.5- 29.0	03/15/90	5	1	7	0.20	0.467	5.5- 29.0	03/22/90	70.30	2.99
							2- 1	29.0- 87.0	04/03/90	29.0- 87.0	04/04/90	25	1.0	7	0.20	0.063	29.0- 87.0	04/04/90	0.40	0.01
A2710	T 27+10.0	10.4	U 5783.30	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	03/30/90		
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	0.1	7	0.02	0.006	29.0- 87.0	04/23/90	0.30	0.01
B2712	S 27+12.5	5.3	U 5784.05	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/02/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/03/90	0.10	0.00
							2- 1	29.0- 87.0	05/11/90	29.0- 87.0	05/14/90	25	1	7	0.20	0.063	29.0- 87.0	05/15/90	2.70	0.05
A2715	S 27+15.0	10.3	U 5784.80	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	1	7	0.20	0.467	5.5- 29.0	03/27/90	0.30	0.01
							2- 1	29.0- 87.0	04/11/90	29.0- 87.0	04/12/90	25	0.3	7	0.06	0.019	29.0- 87.0	04/16/90	4.20	0.07

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2717	P 27+17.5	7.7	U 5785.55	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/17/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/21/90	25	1.8	7	0.36	0.113	29.0- 87.0	05/22/90	0.50	0.01
							3- 1	87.0-174.0	05/29/90	87.0-174.0	05/30/90	53	1.0	7	0.20	0.028	87.0-174.0	05/30/90	0.40	0.00
A2720	T 27+20.0	10.2	U 5786.30	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90	0.40	0.02
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	3.0	7	0.60	0.189	29.0- 87.0	04/23/90	3.30	0.06
B2722	P 27+22.5	5.1	U 5786.95	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/27/90	5.5- 29.0	04/30/90	5	2.7	7	0.54	1.261	15.0- 29.0	04/30/90	1.30	0.09
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	0.20	0.01
							2- 1	29.0- 87.0	05/07/90	29.0- 87.0	05/07/90	25	0.5	7	0.10	0.031	29.0- 87.0	05/08/90	0.50	0.01
A2725	P 27+25.0	10.1	U 5787.60	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/14/90	5.5- 29.0	03/15/90	5	0	7	0.00		5.5- 29.0	03/22/90	0.60	0.03
							2- 1	29.0- 87.0	04/03/90	29.0- 87.0	04/04/90	25	0.8	7	0.16	0.050	29.0- 87.0	04/05/90	0.70	0.01
A2730	T 27+30.0	9.9	U 5789.10	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90	0.50	0.02
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	3.7	7	0.74	0.233	29.0- 87.0	04/23/90	0.90	0.02
B2732	S 27+32.5	4.9	U 5789.85	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/02/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/03/90	0.10	0.00
							2- 1	29.0- 87.0	05/11/90	-	/ /						29.0- 87.0	05/15/90	0.80	0.01
A2735	S 27+35.0	9.8	U 5790.60	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/22/90	5.5- 29.0	03/23/90	5	42	7	8.40	19.619	5.5- 29.0	03/27/90	0.80	0.03
							2- 1	29.0- 87.0	04/11/90	29.0- 87.0	04/12/90	25	1.3	7	0.26	0.082	29.0- 87.0	04/16/90	0.70	0.01
C2737	P 27+37.5	7.3	U 5791.35	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/17/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/21/90	25	0.01	7	0.00		29.0- 87.0	05/22/90	0.10	0.00
							3- 1	87.0-174.0	05/29/90	87.0-174.0	05/31/90	53	0.2	10	0.04	0.006	87.0-174.0	05/31/90	0.20	0.00
A2740	T 27+40.0	9.7	U 5792.10	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90	0.10	0.00
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	0.9	7	0.18	0.057	29.0- 87.0	04/23/90		
B2742	P 27+42.5	4.7	U 5792.75	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2742	P 27+42.5	4.7 U	5792.75	2	321.00	60.00	1- 2	5.5- 29.0	04/27/90	5.5- 29.0	04/30/90	5	01	7	0.20	0.467	15.0- 29.0	04/30/90	1.30	0.09
							- 2	-	/ /	-	/ /						5.5- 29.0	04/30/90	12.90	0.55
							2- 1	29.0- 87.0	05/07/90	29.0- 87.0	05/07/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/08/90	0.10	0.00
A2745	P 27+45.0	9.6 U	5793.40	1	321.00	60.00	1- 1	0.0- 5.5	03/07/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/14/90	5.5- 29.0	03/15/90	5	01	7	0.20	0.467	5.5- 29.0	03/22/90	0.10	0.00
							2- 1	29.0- 87.0	04/04/90	29.0- 87.0	04/04/90	25	0.01	7	0.00		29.0- 87.0	04/05/90	0.10	0.00
A2750	T 27+50.0	9.5 U	5796.30	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90		
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	0.1	7	0.02	0.006	29.0- 87.0	04/23/90		
B2752	S 27+52.5	4.4 U	5797.75	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/03/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/03/90		
							2- 1	29.0- 87.0	05/11/90	29.0- 87.0	05/15/90	25	3.0	7	0.60	0.189	29.0- 87.0	05/15/90	0.10	0.00
A2755	S 27+55.0	9.4 U	5799.20	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/23/90	5.5- 29.0	03/23/90	5	01	7	0.20	0.467	5.5- 29.0	03/27/90		
							2- 1	29.0- 87.0	04/11/90	29.0- 87.0	04/12/90	25	0.3	7	0.06	0.019	29.0- 87.0	04/16/90	1.40	0.02
C2757	P 27+57.5	6.8 U	5800.65	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/17/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/22/90	25	4.6	7	0.92	0.289	29.0- 87.0	05/22/90	0.40	0.01
							3- 1	87.0-174.0	05/30/90	87.0-174.0	05/31/90	53	4.9	10	0.98	0.139	87.0-174.0	05/31/90	41.20	0.47
A2760	T 27+60.0	9.3 U	5802.10	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90	0.10	0.00
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	0.1	7	0.02	0.006	29.0- 87.0	04/24/90	0.30	0.01
B2762	P 27+62.5	4.2 U	5803.50	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/27/90	5.5- 29.0	04/30/90	5	01	7	0.20	0.467	5.5- 29.0	05/01/90	0.40	0.02
							2- 1	29.0- 87.0	05/07/90	29.0- 87.0	05/08/90	25	0.5	7	0.10	0.031	29.0- 87.0	05/08/90		
A2765	P 27+65.0	9.2 U	5804.90	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/19/90	5.5- 29.0	03/19/90	5	11.3	7	2.26	5.279	5.5- 29.0	03/22/90	0.50	0.02
							2- 1	29.0- 87.0	04/04/90	29.0- 87.0	04/04/90	25	11.2	7	2.24	0.705	29.0- 87.0	04/05/90	45.40	0.78
A2770	T 27+70.0	9.1 U	5807.40	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90	0.50	0.02
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	5.8	7	1.16	0.365	29.0- 87.0	04/24/90	5.60	0.10

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
B2772	S 27+72.5	4.0	U 5808.95	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/03/90	5	0.2	7	0.04	0.093	5.5- 29.0	05/03/90	0.30	0.01
							2- 1	29.0- 87.0	05/14/90	29.0- 87.0	05/15/90	25	6.4	7	1.28	0.403	29.0- 87.0	05/15/90	29.80	0.51
A2775	S 27+75.0	9.0	U 5809.90	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/23/90	5.5- 29.0	03/23/90	5	25	7	5.00	11.678	5.5- 29.0	03/27/90	0.60	0.03
							2- 1	29.0- 87.0	04/12/90	29.0- 87.0	04/12/90	25	5.2	7	1.30	0.409	29.0- 87.0	04/16/90	6.60	0.11
C2777	P 27+77.5	6.4	U 5811.15	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/16/90	5.5- 29.0	05/17/90	5	0.4	7	0.08	0.590	-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/22/90	25	5.7	7	1.14	0.359	29.0- 87.0	05/22/90	1.10	0.02
							3- 1	87.0-174.0	05/30/90	87.0-174.0	05/31/90	53	4.7	10	0.94	0.134	87.0-174.0	05/31/90	5.60	0.06
A2780	T 27+80.0	8.8	U 5812.40	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	10	7	2.00	4.671	5.5- 29.0	04/02/90	0.60	0.03
							2- 1	29.0- 87.0	04/20/90	29.0- 87.0	04/23/90	25	6.1	7	1.22	0.384	29.0- 87.0	04/24/90	1.20	0.02
B2782	P 27+82.5	3.8	U 5813.95	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/27/90	5.5- 29.0	04/30/90	5	7.5	7	1.50	3.503	5.5- 29.0	05/01/90	0.10	0.00
							2- 1	29.0- 87.0	05/07/90	29.0- 87.0	05/08/90	25	6.6	7	1.32	0.415	29.0- 87.0	05/08/90	0.40	0.01
A2785	P 27+85.0	8.7	U 5814.90	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/19/90	5.5- 29.0	03/19/90	5	10.9	7	2.18	5.092	5.5- 29.0	03/22/90	1.00	0.04
							2- 1	29.0- 87.0	04/04/90	-	/ /						29.0- 87.0	04/05/90	19.90	0.34
A2790	T 27+90.0	8.6	U 5816.50	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	0.01	7	0.00		5.5- 29.0	04/02/90	0.20	0.01
							2- 1	29.0- 87.0	04/23/90	29.0- 87.0	04/23/90	25	7.5	7	1.50	0.472	29.0- 87.0	04/24/90	1.70	0.03
B2792	S 27+92.5	3.6	U 5818.30	2	321.00	60.00	1- 1	0.0- 5.5	04/25/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/01/90	5.5- 29.0	05/03/90	5	0.1	7	0.02	0.047	5.5- 29.0	05/03/90	6.60	0.28
							2- 1	29.0- 87.0	05/11/90	29.0- 87.0	05/15/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/15/90	0.10	0.00
A2795	S 27+95.0	8.5	U 5818.10	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/23/90	5.5- 29.0	03/23/90	5	83	7	16.60	38.771	5.5- 29.0	03/27/90	0.30	0.01
							2- 1	29.0- 87.0	04/12/90	-	/ /						29.0- 87.0	04/16/90	1.70	0.03
C2797	P 27+97.5	6.0	U 5818.90	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/17/90	5.5- 29.0	05/17/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/22/90	25	1.0	7	0.20	0.063	29.0- 87.0	05/22/90	0.10	0.00

Table 6 (Continued)

HOLE NO.	STATION	OFFSET	TOP OF HOLE ELEV	LINE	AZIM	INCLINE	ZONE & STAGE	DRILLING DATA DEPTH (FT)	DRILLING DATA DATE COMPLETED	WATER PRESSURE TEST DATA DEPTH (FT)	DATE	PRES (PSI)	TOTAL CF	ET	FLOW RATE (GPM)	Ke	GROUTING DATA DEPTH (FT)	DATE	TAKE (SACKS)	SACKS /FT
C2797	P 27+97.5	6.0 U	5818.90	3	321.00	60.00	3- 1	87.0-174.0	05/30/90	87.0-174.0	05/31/90	53	1.9	10	0.38	0.054	87.0-174.0	05/31/90	1.50	0.02
A2800	T 28+00.0	8.4 U	5819.70	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/29/90	5.5- 29.0	03/29/90	5	3.3	7	0.66	1.542	5.5- 29.0	04/02/90	0.70	0.03
							2- 1	29.0- 87.0	04/23/90	29.0- 87.0	04/23/90	25	6.1	7	1.22	0.384	29.0- 87.0	04/24/90	1.50	0.03
							- 1	-	/ /	-	/ /						0.0- 87.0	04/25/90	22.40	0.26
B2802	P 28+02	3.5 U	5820.40	2	321.00	60.00	1- 1	0.0- 5.5	04/24/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	04/29/90	5.5- 29.0	04/30/90	5	4.7	7	0.94	2.195	5.5- 29.0	05/01/90	1.30	0.06
							2- 1	29.0- 87.0	05/07/90	29.0- 87.0	05/08/90	25	0.1	7	0.02	0.006	29.0- 87.0	05/08/90		
A2805	P 28+05.0	8.3 U	5821.10	1	321.00	60.00	1- 1	0.0- 5.5	03/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	03/19/90	5.5- 29.0	03/19/90	5	10.8	7	2.16	5.045	5.5- 29.0	03/22/90	1.00	0.04
							2- 1	29.0- 87.0	04/04/90	29.0- 87.0	04/05/90	25	3.6	7	0.72	0.227	29.0- 87.0	04/05/90	1.10	0.02
C2817	P 28+17	6.0 U	5824.50	3	321.00	60.00	1- 1	0.0- 5.5	05/15/90	-	/ /						-	/ /		
							- 2	5.5- 29.0	05/17/90	5.5- 29.0	05/17/90	5	0.01	7	0.00		-	/ /		
							2- 1	29.0- 87.0	05/21/90	29.0- 87.0	05/22/90	25	1.3	7	0.26	0.082	29.0- 87.0	05/22/90	0.20	0.00
							3- 1	87.0-174.0	05/30/90	87.0-174.0	05/31/90	53	1.1	10	0.22	0.031	87.0-174.0	05/31/90	3.70	0.04

Table 6 (Concluded)

TABLE 7

Detailed Summary of Drilling and Grouting in Tunnel

DETAILED SUMMARY OF DRILLING AND GROUTING IN TUNNEL

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
10+40	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	D	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+47	A	3.6	13.0	3.0	0.1
	B	3.0	13.0	0.0	0.2
	C	2.5	-	-	54.6
	D	3.3	-	1.1	0.1
	E	4.0	-	0.6	0.8
	F	3.8	-	0.3	0.6
	G	-	-	-	0.2
	H	2.5	13.0	15.6	0.0
10+51	A	5.0	-	0.6	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+54.	A	4.0	-	0.6	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+57	A	4.0	-	0.1	-
	B	4.0	-	-	-
	C	4.0	-	0.9	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+64	A	4.0	-	0.1	-
	B	5.0	-	0.3	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+67.	A	5.0	4.0	0.7	-
	B	5.0	4.0	-	-
	C	5.6	13.0	-	22.7
	D	4.0	13.0	0.2	53.4
	E	4.0	8.5	0.2	0.2

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	5.0	5.0	-	Comm
10+76.	A	4.5	-	0.4	-
	B	3.7	-	-	-
	C	3.6	-	44.7	-
	D	. -	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+87.	A	5.0	4.0	-	Comm Top
	B	5.0	13.0	-	8.6
	C	13.0	-	-	38.8
	D	4.4	13.0	13.4	0.1
	E	3.4	13.0	Comm	49.9
	F	5.8	13.0	Comm	76.8
	G	13.0	13.0	-	0.1
	H	5.0	5.0	-	Comm
10+89	A	6.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+92	A	6.3	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
10+97.	A	4.2	-	0.4	-
	B	4.2	-	Comm	-
	C	4.1	-	95.2	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+03	A	5.0	-	1.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+07	A	5.0	4.0	0.7	-
	B	5.0	5.0	0.0	-
	C	-	5.5	-	39.1
	D	4.6	13.0	0.1	1.3
	E	4.4	13.0	Comm	0.1
	F	4.4	13.0	Comm	Comm
	G	-	13.0	-	-
	H	5.0	9.0	0.0	Comm
11+10.	A	3.9	-	7.5	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
	D	-	-	-	-
	E				
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+17.	A	3.8	-	3.6	-
	B	5.0	-	1.8	-
	C	4.6	-	0.0	-
	D	4.7	-	Comm	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+28	A	5.0	4.0	0.0	Comm
	B	5.0	6.0	0.0	-
	C	-	13.0	-	0.2
	D	6.6	13.0	119.7	0.3
	E	4.9	13.0	Comm	0.7
	F	4.8	13.0	-	0.1
	G	-	13.0	-	1.7
	H	5.0	4.0	0.0	Comm
11+31	A	4.0	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	-	-	-	-
11+39	A	4.8	-	5.9	-
	B	4.6	-	Comm	-
	C	. 6.8	-	0.7	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+44	A	4.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+47.5	A	5.0	13.0	0.0	30.0 Top
	B	5.0	5.0	0.1	Comm
	C	-	13.0	-	24.1
	D	3.8	13.0	0.0	61.0
	E	2.9	13.0	-	-
	F	3.0	13.0	21.0	81.0
	G	-	13.0	-	0.0
	H	5.0	5.0	0.3	Comm
11+57.5	A	4.6	-	Comm	-
	B	4.8	-	Comm	-
	C	5.0	-	0.1	-
	D	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+62	A	5.2	-	3.6	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+67	A	5.0	3.0	0.1	-
	B	5.0	5.0	0.0	-
	C	-	13.0	-	0.5
	D	4.8	13.0	Comm	0.0
	E	4.5	13.0	Comm	0.0
	F	4.1	13.0	0.1	0.2
	G	-	13.0	-	7.9
	H	5.0	4.0	0.3	-
11+77	A	4.8	-	55.2	-
	B	4.7	-	Comm	-
	C	4.8	-	Comm	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+87.	A	5.0	13.0	0.0	Top

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	5.0	7.0	0.0	-
	C	4.9	13.0	-	15.9
	D	4.8	13.0	Comm	0.1
	E	2.9	13.0	Comm	0.2
	F	-	13.0	Comm	32.0
	G	5.0	13.0	-	0.1
	H	5.0	7.0	0.0	Comm
11+91.	A	4.8	-	1.0	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
11+97.	A	4.1	-	0.1	-
	B	4.1	-	0.1	-
	C	3.2	-	0.1	-
	D	4.5	-	Comm	-
	E	4.1	-	0.7	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
12+07.	A	5.0	0.0	0.1	-
	B	5.0	13.0	24.5	47.2
	C	-	13.0	-	35.2
	D	4.8	13.0	46.4	5.0
	E	4.3	13.0	Comm	16.7
	F	4.2	13.0	1.0	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	13.0	-	9.6
	H	5.0	13.0	0.1	0.0
12+10	A	6.5	-	0.4	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
12+16	A	5.0	-	2.2	Comm
	B	5.0	-	-	-
	C	5.0	-	-	-
	D	4.8	-	-	-
	E	4.9	-	-	-
	F	-	-	-	-
	G	5.0	-	-	-
	H	-	-	-	Comm
12+17.	A	5.0	5.0	0.1	Comm
	B	5.0	4.0	-	2.1
	C	-	13.0	-	1.0
	D	-	13.0	-	0.1
	E	-	13.0	-	62.5
	F	-	13.0	-	0.0
	G	-	13.0	-	6.1
	H	5.0	5.0	0.2	Comm
12+20.	A	5.1	-	1.5	-
	B	5.1	-	2.5	-
	C	-	-	-	-
	D	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
12+23	A	5.0	8.0	0.1	-
	B	5.0	4.0	-	-
	C	5.0	13.0	Comm	0.1
	D	5.1	13.0	Comm	0.0
	E	4.9	13.0	Comm	7.1
	F	-	13.0	Comm	0.1
	G	5.0	13.0	-	0.0
	H	5.0	13.0	-	Comm Top
12+27.	A	4.0	13.0	0.2	0.3 Top
	B	4.6	13.0	0.7	13.9 Top
	C	4.9	13.0	Comm	0.2
	D	4.5	13.0	Comm	4.4
	E	4.0	13.0	Comm	9.8
	F	5.1	13.0	0.1	1.8
	G	5.0	13.0	0.6	0.0
	H	4.0	13.0	1.0	8.6 Top
12+29	A	4.7	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
12+31	A	4.0	-	Comm	0.0 Top
	B	4.0	-	Comm	5.0 Top
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	4.0	-	Comm	0.3 Top
12+33	A	-	13.0	8.8	-
	B	-	13.0	-	-
	C	4.9	13.0	0.1	0.4
	D	4.4	13.0	0.2	0.2
	E	4.9	13.0	0.2	0.1
	F	4.8	13.0	1.6	0.2
	G	4.8	13.0	0.1	21.6
	H	-	13.0	-	-
12+37	A	4.0	13.0	-	0.0 Top
	B	4.0	13.0	20.1	0.4 Top
	C	4.6	13.0	0.1	0.4
	D	4.9	13.0	0.1	30.1
	E	4.9	13.0	0.1	0.0
	F	4.9	13.0	1.7	1.0
	G	4.8	-	0.3	35.1
	H	4.0	13.0	13.0	0.1 Top
12+43.	A	6.0	13.0	0.2	0.0 Top
	B	6.0	7.0	Comm	-
	C	4.0	-	0.2	0.5
	D	4.6	-	28.7	59.0
	E	4.6	-	Comm	8.5
	F	4.6	13.0	0.0	1.4
	G	4.4	13.0	-	1.5
	H	6.0	6.0	0.4	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
12+48.	A	5.0	10.0	13.6	-
	B	5.5	5.0	Comm	-
	C	4.7	13.0	4.0	0.5
	D	4.9	13.0	Comm	35.8
	E	3.9	13.0	Comm	0.2
	F	4.6	13.0	Comm	20.4
	G	4.8	13.0	3.6	1.3
	H	5.0	13.0	-	-
12+53	A	5.0	9.0	0.1	-
	B	5.0	13.0	0.0	0.2 Top
	C	5.1	13.0	0.0	0.2
	D	4.8	13.0	0.0	0.0
	E	4.8	13.0	Comm	0.0
	F	3.1	13.0	0.4	0.0
	G	4.8	13.0	Comm	34.3
	H	5.0	13.0	1.5	0.2 Top
12+57	A	4.7	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
12+59	A	5.0	13.0	0.1	0.3 Top
	B	5.0	4.0	0.1	-
	C	5.0	13.0	0.7	0.0
	D	4.7	13.0	0.7	5.2
	E	4.9	11.0	Comm	0.1
	F	5.1	13.0	1.8	0.4

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	4.6	13.0	0.7	0.0
	H	5.0	10.0	Comm	-
12+64	A	5.0	13.0	0.1	0.0 Top
	B	6.5	13.0	0.1	0.2 Top
	C	4.7	13.0	0.0	-
	D	5.0	13.0	73.7	0.0
	E	5.0	13.0	Comm	0.2
	F	5.0	13.0	Comm	0.3
	G	4.3	13.0	5.8	32.0
	H	5.0	13.0	0.1	-
12+67.	A	-	-	1.0	-
	B	-	-	0.0	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	0.0	-
12+69	A	5.0	13.0	17.3	1.7 Top
	B	5.0	3.0	0.1	-
	C	4.6	13.0	1.1	0.2
	D	4.8	13.0	Comm	0.1
	E	4.8	13.0	Comm	0.1
	F	4.1	13.0	Comm	6.1
	G	4.9	13.0	0.0	0.1
	H	5.0	13.0	7.0	Comm
12+75	A	5.0	5.0	0.1	-
	B	5.0	13.0	6.2	0.2
	C	4.7	8.0	0.3	0.1
	D	4.7	13.0	Comm	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	4.8	13.0	Comm	1.1
	F	5.1	-	Comm	33.8
	G	4.7	13.0	0.0	0.4
	H	5.0	13.0	0.0	1.2 Top
12+80	A	5.0	4.0	0.0	Comm
	B	5.0	13.0	1.1	0.4 Top
	C	4.6	13.0	Comm	0.0
	D	4.6	13.0	Comm	0.1
	E	4.0	13.0	Comm	0.0
	F	4.4	13.0	Comm	0.1
	G	4.3	13.0	3.7	0.2
	H	5.0	13.0	-	2.2 Top
12+87	A	5.0	7.0	18.9	Comm
	B	5.0	9.0	0.0	-
	C	4.3	13.0	Comm	0.1
	D	4.2	13.0	0.0	0.1
	E	4.1	13.0	Comm	0.0
	F	4.4	13.0	0.0	0.2
	G	3.7	13.0	Comm	0.2
	H	5.0	13.0	0.0	-
12+88.	A	4.8	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
12+92	A	5.0	5.0	23.9	Comm

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	5.0	13.0	0.7	0.2 Top
	C	4.0	13.0	0.3	0.1
	D	3.9	13.0	39.9	0.2
	E	3.9	13.0	Comm	0.2
	F	3.9	13.0	Comm	2.0
	G	4.3	13.0	3.4	0.0
	H	5.0	13.0	Comm	0.1 Top
12+97	A	5.0	13.0	Comm	Comm Top
	B	5.0	8.0	Comm	Comm Top
	C	4.3	13.0	-	0.0
	D	4.0	13.0	Comm	0.3
	E	4.0	13.0	Comm	0.2
	F	4.0	13.0	Comm	0.3
	G	4.9	13.0	0.0	0.2
	H	5.0	13.0	0.0	Comm Top
12+98.	A	4.6	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
13+02	A	5.0	13.0	0.0	0.3 Top
	B	5.0	13.0	0.0	0.1 Top
	C	4.3	13.0	Comm	3.1
	D	4.3	13.0	Comm	0.0
	E	4.0	13.0	Comm	2.0
	F	3.3	13.0	Comm	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	4.6	13.0	-	0.1
	H	5.0	13.0	0.1	0.1 Top
13+05	A	4.0	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
13+06.	A	5.0	13.0	31.2	Comm Top
	B	5.0	13.0	32.6	Comm Top
	C	4.5	13.0	4.4	0.1
	D	4.2	13.0	0.0	0.1
	E	4.1	13.0	Comm	0.1
	F	4.2	13.0	Comm	0.0
	G	4.3	13.0	0.7	0.1
	H	5.0	13.0	10.2	0.1 Top
13+07	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	5.0	-	-	-
13+12.	A	5.0	13.0	0.1	Comm Top
	B	5.0	13.0	-	0.4 Top
	C	4.4	13.0	0.2	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	3.9	13.0	2.5	0.2
	E	4.3	13.0	0.1	0.3
	F	4.2	13.0	Comm	1.1
	G	4.0	13.0	-	0.3
	H	5.0	13.0	0.1	0.1 Top
13+18	A	5.0	13.0	Comm	Comm Top
	B	5.0	13.0	Comm	0.0
	C	6.5	13.0	Comm	0.1
	D	4.5	13.0	0.7	1.0
	E	4.0	13.0	0.2	0.1
	F	5.1	13.0	Comm	0.1
	G	4.0	13.0	0.1	1.1
	H	5.0	13.0	0.1	0.1 Top
13+22	A	5.0	13.0	0.1	0.3 Top
	B	4.0	13.0	Comm	0.1 Top
	C	4.7	13.0	-	1.6
	D	3.8	13.0	0.6	0.1
	E	4.2	13.0	7.2	0.0
	F	4.8	13.0	0.1	0.2
	G	5.0	13.0	2.9	0.1
	H	4.5	13.0	0.1	0.1 Top
13+24	A	4.6	-	167.3	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
13+26	A	4.5	13.0	Comm	0.0 Top

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	3.8	13.0	0.3	0.1 Top
	C	4.8	13.0	0.1	0.0
	D	4.6	13.0	Comm	0.0
	E	4.4	13.0	0.1	0.1
	F	4.0	13.0	0.1	0.1
	G	4.2	13.0	0.4	0.0
	H	4.5	13.0	0.0	0.0 Top
13+29	A	4.0	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
13+31	A	2.0	13.0	Comm	0.0 Top
	B	4.0	13.0	Comm	0.2 Top
	C	4.6	13.0	0.7	0.1
	D	4.4	13.0	Comm	0.1
	E	4.0	13.0	Comm	0.1
	F	4.0	13.0	Comm	0.0
	G	4.1	13.0	0.4	0.0
	H	4.0	13.0	0.0	0.0 Top
13+35	A	4.0	13.0	3.0	Comm Top
	B	4.0	13.0	0.2	1.3
	C	4.6	13.0	2.7	0.2
	D	4.9	13.0	Comm	0.1
	E	4.1	13.0	Comm	0.1
	F	3.8	13.0	-	0.7

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	4.8	13.0	Comm	0.2
	H	4.0	13.0	0.1	0.2 Top
13+39	A	4.0	13.0	0.9	0.3 Top
	B	4.0	13.0	0.2	Comm Top
	C	4.4	13.0	0.2	0.1
	D	4.5	13.0	Comm	0.1
	E	5.0	13.0	Comm	0.0
	F	3.9	13.0	Comm	0.1
	G	4.5	13.0	Comm	0.1
	H	4.0	13.0	0.1	0.0 Top
13+43	A	4.0	13.0	0.4	0.3 Top
	B	4.0	13.0	0.3	0.1 Top
	C	4.0	13.0	-	0.1
	D	4.1	13.0	Comm	0.1
	E	4.0	13.0	-	0.0
	F	3.7	13.0	Comm	0.1
	G	4.6	13.0	Comm	0.4
	H	4.3	13.0	0.0	Comm Top
13+49	A	4.6	13.0	0.1	2.0 Top
	B	4.8	13.0	0.1	0.0 Top
	C	5.7	13.0	-	0.3
	D	4.0	13.0	Comm	0.2
	E	4.5	13.0	0.3	0.1
	F	4.3	13.0	Comm	0.1
	G	4.7	13.0	0.2	0.0
	H	4.0	13.0	0.0	0.6
13+53.	A	4.9	13.0	0.1	-
	B	-	-	-	-
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	0.0	-
	E	-	-	-	-
	F	-	-	0.0	-
	G	-	13.0	5.8	-
	H	-	-	-	-
13+55	A	13.0	-	-	-
	B	9.0	-	-	-
	C	5.8	20.0	0.7	-
	D	8.6	20.0	-	-
	E	6.7	20.0	-	-
	F	6.1	20.0	-	-
	G	7.0	20.0	-	-
	H	13.0	9.0	-	-
13+61	A	-	-	-	-
	B	-	-	-	-
	C	6.9	16.0	0.0	0.1
	D	-	30.0	0.0	27.1
	E	-	13.0	0.0	60.9
	F	-	30.0	0.7	34.0
	G	8.4	30.0	-	32.8
	H	-	-	-	-
13+68.5	A	10.6	24.2	916.7	29.9
	B	9.3	25.5	Comm	0.4
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	J	-	-	-	-
	K	-	-	-	-
13+70	A	-	30.0	-	5.2
	B	-	-	Elimin-ated	-
	C	5.0	29.8	0.0	29.8
	D	5.0	29.8	Comm	0.6
	E	6.6	28.2	Comm	30.5
	F	6.6	28.2	0.7	2.1
	G	-	29.8	-	39.2
	H	-	30.0	-	2.0
	I	-	30.0	-	4.1
	J	-	30.0	-	31.8
	K	-	30.0	-	5.3
13+71	A	7.8	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
13+75	A	-	30.0	-	7.1
	B	-	30.0	-	0.2
	C	-	30.0	-	0.0
	D	6.9	27.9	-	0.4
	E	3.8	31.0	Comm	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	-	30.0	-	0.3
	G	-	30.0	-	0.1
	H	-	30.0	-	0.3
	I	-	30.0	-	37.5
	J	-	30.0	-	0.1
	K	-	-	-	-
13+80	A	-	30.0	-	0.4
	B	-	30.0	-	0.8
	C	5.0	29.8	0.0	2.6
	D	4.8	30.0	Comm	71.4
	E	13.0	21.8	287.3	1.4
	F	4.6	30.2	0.1	2.3
	G	Elimin-ated	30.0	-	0.0
	H	-	30.0	-	0.1
	I	-	30.0	-	4.8
	J	-	30.0	-	11.0
	K	-	30.0	-	0.8
13+81	A	7.0	-	Comm	-
	B	6.6	-	10.1	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
13+83	A	7.0	Comm	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
13+85.5	A	-	30.0	-	0.8
	B	-	30.0	-	1.7
	C	5.6	29.2	0.0	0.4
	D	5.5	29.3	Comm	0.3
	E	4.6	30.2	Comm	0.0
	F	5.0	30.0	Comm	1.7
	G	-	30.0	-	0.2
	H	-	30.0	-	0.0
	I	-	30.0	-	0.0
	J	-	30.0	-	0.4
	K	-	30.0	-	0.2
13+90.5	A	-	30.0	-	4.6
	B	-	Eliminated	-	-
	C	5.0	29.8	0.0	0.0
	D	6.0	28.8	Comm	15.4
	E	4.6	30.2	13.6	0.0
	F	6.0	28.9	0.0	0.2
	G	-	30.0	-	0.2
	H	-	30.0	-	0.3

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	I	-	30.0	-	0.1
	J	-	30.0	-	56.0
	K	-	30.0	-	2.8
13+92	A	6.6	Comm	-	-
	B	5.6	Comm	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
13+94.5	A	-	30.0	-	1.7
	B	-	30.0	-	0.4
	C	5.2	Comm	29.6	0.2
	D	6.0	Comm	28.8	0.2
	E	7.0	28.8	0.3	1.8
	F	4.5	29.8	0.1	0.4
	G	-	30.0	-	0.7
	H	-	30.0	-	6.8
	I	-	30.0	-	0.0
	J	-	30.0	-	0.5
	K	-	-	-	-
13+99.5	A	-	30.0	-	0.0
	B	-	30.0	-	2.0
	C	6.0	28.8	0.7	0.9
	D	6.6	28.2	Comm	12.9

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	5.6	29.2	Comm	4.1
	F	5.0	29.8	Comm	0.3
	G	-	Eliminated	-	-
	H	-	30.0	-	0.9
	I	-	30.0	-	11.5
	J	-	30.0	-	0.2
	K	-	30.0	-	0.0
14+04	A	-	30.0	-	1.7
	B	-	30.0	-	0.1
	C	5.2	29.6	Comm	0.1
	D	4.6	28.2	Comm	0.3
	E	4.6	30.2	-	0.8
	F	-	30.0	-	0.2
	G	-	30.0	-	0.3
	H	-	30.0	-	0.0
	I	-	30.0	-	1.3
	J	-	30.0	-	0.1
	H	-	-	-	-
14.09.5	A	-	30.0	-	0.8
	B	-	Eliminated	-	-
	C	6.0	28.8	0.0	0.6
	D	5.0	29.8	Comm	40.6
	E	5.9	28.9	Comm	44.0
	F	5.0	29.8	0.0	0.3
	G	-	30.0	-	0.4
	H	-	30.0	-	8.7
	I	-	30.0	-	16.0
	J	-	30.0	-	0.0
	K	-	30.0	-	2.0

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
14+14.5	A	-	30.0	-	0.1
	B	-	30.0	-	3.3
	C	5.2	29.6	0.0	0.6
	D	5.0	29.8	0.0	0.2
	E	5.0	29.8	Comm	0.3
	F	-	30.0	-	0.2
	G	-	30.0	-	0.1
	H	-	30.0	-	0.0
	I	-	30.0	-	0.0
	J	-	30.0	-	0.1
	K	-	-	-	-
14+19.5	A	-	30.0	-	0.2
	B	-	30.0	-	0.3
	C	5.8	29.0	1.2	0.6
	D	5.0	29.5	Comm	0.2
	E	5.3	29.8	Comm	0.0
	F	4.8	30.0	0.0	3.6
	G	-	Eliminated	-	-
	H	-	30.0	-	0.2
	I	-	30.0	-	1.2
	J	-	30.0	-	0.2
	K	-	30.0	-	4.8
14+24.5	A	-	30.0	-	0.2
	B	-	30.0	-	0.2
	C	7.2	27.6	Comm	1.4
	D	4.2	30.3	0.0	0.7
	E	4.5	30.3	0.0	0.2
	F	-	30.0	-	0.3
	G	-	30.0	-	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	-	30.0	-	0.0
	I	-	30.0	-	0.0
	J	-	30.0	-	0.1
	K	-	-	-	-
14+28	A	-	30.0	-	0.7
	B	-	30.0	-	0.0
	C	7.2	27.1	169.3	9.0
	D	4.2	30.0	2.4	18.0
	E	7.0	27.8	Comm	30.0
	F	6.7	28.1	0.1	0.0
	G	-	30.0	-	0.2
	H	-	30.0	-	3.8
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
14+29	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
14+30	A	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	7.6	-	-	-
	D	9.0	-	-	-
	E	7.0	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
	J	-	-	-	-
	K	-	-	-	-
14+33	A	8.2	8.8	0.3	7.4
	B	10.0	10.8	2.2	1.0
	C	10.0	10.8	0.3	0.3
	D	13.0	7.8	0.3	0.0
	E	9.8	-	-	-
	F	2.0	12.6	NG	0.7
	G	3.2	12.6	-	0.0
	H	-	-	-	-
	I	-	-	-	-
14+36.5	A	1.6	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14.39	A	3.3	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	3.3	-	Comm	-
	C	4.0	-	0.3	-
	D	4.0	-	0.0	-
	E	-	-	-	-
	F	4.9	-	-	-
	G	6.0	-	-	-
	H	4.2	-	-	-
	I	-	-	-	-
14+41.5	A	6.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+43	A	-	13.2	-	0.3
	B	5.0	10.8	2.4	1.0
	C	4.8	11.0	0.0	3.4
	D	3.9	11.9	6.4	0.3
	E	-	13.2	-	0.0
	F	4.2	13.6	-	0.3
	G	4.4	11.4	-	0.3
	H	3.0	12.0	-	0.9
	I	-	-	-	-
14+47	A	6.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+49	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	4.6	-	-	-
	G	5.6	-	-	-
	H	5.6	-	-	-
	I	-	-	-	-
MONO A-2					
14+51.5	A	4.6	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+53.5	A	-	10.2	-	0.3
	B	4.0	9.0	Comm	0.0
	C	ND	10.2	-	1.6
	D	5.0	7.8	0.0	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	10.2	-	0.1
	F	5.0	7.8	-	0.0
	G	4.0	8.8	-	0.0
	H	5.0	7.8	-	0.0
	I	-	-	-	-
14+57	A	5.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14.58.5	A	-	-	-	-
	B	-	-	-	-
	C	3.2	-	-	-
	D	5.0	-	-	-
	E	4.2	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+61.5	A	5.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+64.5	A	-	10.2	-	0.3
	B	12.6	7.4	11.2	0.1
	C	4.8	8.0	0.3	0.0
	D	4.9	7.9	0.0	0.1
	E	-	10.2	-	0.1
	F	5.0	7.8	-	0.1
	G	5.0	7.8	-	0.1
	H	5.0	7.8	-	0.0
	I	-	-	-	-
14+66.3	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+68.3	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	4.0	-	-	-
	G	3.0	-	-	-
	H	4.0	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	I	-	-	-	-
14+73.5	A	-	10.2	-	19.0
	B	4.6	8.2	0.0	18.1
	C	4.8	8.0	Comm	0.1
	D	4.9	7.9	45.7	0.0
	E	-	10.2	-	2.7
	F	4.0	8.8	-	0.0
	G	3.6	9.2	-	0.0
	H	4.0	8.8	-	0.0
	I	-	-	-	-
14+78.5	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	4.6	-	0.0	-
	E	3.0	-	0.0	-
	F	3.9	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
MONO A-3					
14+84	A	-	10.2	-	0.0
	B	4.9	7.9	0.0	0.0
	C	4.8	8.0	Comm	0.0
	D	3.0	9.8	Comm	0.2
	E	-	10.2	-	7.6
	F	3.9	8.9	-	0.2
	G	3.0	9.8	-	0.0
	H	4.0	8.8	-	0.0
	I	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
14+86	A	3.9	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	3.0	-	-	-
	H	3.1	-	-	-
	I	-	-	-	-
14+87.8	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	4.0	-	-	-
	G	3.4	-	-	-
	H	3.2	-	-	-
	I	-	-	-	-
MONO A-3					
14+92	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+93.8	A	-	10.2	-	0.1

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	4.9	7.9	0.7	0.0
	C	5.0	7.8	0.4	0.0
	D	4.0	8.8	0.0	3.4
	E	-	10.2	-	0.0
	F	4.4	8.4	-	-
	G	3.2	9.4	-	-
	H	3.2	9.5	-	-
	I	-	-	-	-
14+96	A	3.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
14+98.8	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	4.0	-	-	-
	G	4.0	-	-	-
	H	4.0	-	-	-
	I	-	-	-	-
15+01.8	A	3.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+03.8	A	-	10.2	-	0.1
	B	4.5	8.3	1.4	0.1
	C	3.0	9.8	1.4	0.0
	D	4.0	8.8	0.1	0.0
	E	-	10.2	-	-
	F	4.0	8.8	-	0.2
	G	3.5	9.3	-	0.1
	H	4.0	8.8	-	0.1
	I	-	-	-	-
15+06.3	A	4.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+08.8	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	3.5	-	-	-
	G	3.5	-	-	-
	H	4.0	-	-	-
	I	-	-	-	-
15+11.25	A	4.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+13.3	A	-	10.2	-	0.0
	B	3.2	9.6	12.5	0.0
	C	3.0	9.9	0.2	0.0
	D	6.0	6.8	21.5	0.1
	E	-	10.4	-	0.1
	F	3.5	9.3	-	0.1
	G	3.5	9.3	-	0.0
	H	4.0	8.8	-	0.0
	I	-	-	-	-
15+15.8	A	4.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	-	-	-	-
	I	-	-	-	-
MONO A-4					
15+18.75	A	4.4	-	-	-
	B	4.0	-	-	-
	C	4.0	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+21.5	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+23.75	A	-	10.2	-	0.0
	B	2.8	-	0.0	0.0
	C	2.8	10.0	1.4	0.1
	D	2.8	10.0	0.1	0.1
	E	-	10.2	-	0.7
	F	3.0	9.8	-	2.2
	G	4.0	8.8	-	0.0
	H	3.5	9.3	-	0.0

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	I	4.5	-	-	-
15+26	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+28	A	5.6	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+29	A	5.4	-	-	-
	B	3.2	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+31	A	5.0	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I				
15+33.25	A	-	9.8	-	0.1
	B	3.0	9.8	0.2	0.0
	C	4.7	8.1	0.1	0.1
	D	4.6	8.2	0.1	0.1
	E	-	10.2	-	0.5
	F	4.2	8.6	-	-
	G	3.2	9.6	-	-
	H	3.6	9.2	-	-
	I	-	-	-	-
15+36.25	A	3.3	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+38.5	A	4.0	-	-	-
	B	3.0	-	-	-
	C	NOT DRILLED	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+41	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
MONO A-4					
15+43.5	A	4.0	10.2	-	2.5
	B	-	6.8	-	0.1
	C	-	8.8	-	0.1
	D	-	8.8	-	0.0
	E	-	10.2	-	15.5
	F	-	8.8	-	0.0
	G	-	8.8	-	7.2
	H	-	8.8	-	0.1
	I	-	-	-	-
15+44	A	3.2	-	-	-
	B	4.0	-	-	-
	C	3.2	-	-	-
	D	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+45.7	A	-	-	-	-
	B	3.2	-	0.5	-
	C	3.2	-	0.0	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+46	A	3.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+47.75	A	4.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+48	A	3.0	-	-	-
	B	4.0	-	-	-
	C	4.0	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+48.5	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	5.0	-	-	-
	H	-	-		-
	I	-	-	-	-
15.51	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
MONO A-5					
15+53.75	A	-	10.2	-	1.3
	B	3.7	9.1	79.8	0.0
	C	3.0	7.8	0.3	0.0
	D	3.0	9.8	Comm	0.4
	E	-	10.2	-	40.3
	F	3.0	8.5	-	0.0
	G	3.5	9.8	-	0.0
	H	4.6	8.2	-	0.0
	I	-	-	-	-
15+56.25	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+58.25	A	4.0	-	-	-
	B	3.0	-	-	-
	C	4.3	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+61.25	A	3.0	-	-	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+63.75	A	-	10.2	-	0.0
	B	3.0	9.8	5.3	0.0
	C	3.0	9.8	Comm	0.0
	D	3.0	9.8	Comm	26.7
	E	-	10.2	-	0.0
	F	4.0	8.8	-	0.0
	G	4.0	8.8	-	0.1
	H	4.0	8.8	-	0.0
15+66.25	A	4.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+67.75	A	4.0	-	-	-
	B	3.5	-	-	-
	C	5.0	-	-	-
	D	-	-	-	-
	E	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+70.75	A	4.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+72.75	A	-	10.2	-	0.0
	B	4.4	8.4	114.7	0.0
	C	3.0	9.8	Comm	0.0
	D	3.0	9.8	0.0	0.1
	E	-	10.2	-	24.0
	F	5.0	7.8	-	2.1
	G	4.0	8.8	-	0.0
	H	5.0	7.8	-	0.0
	I	-	-	-	-
15+76	A	4.0	-	-	-
	B	-	-	-	-
	C	4.8	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	-	-	-	-
	I	-	-	-	-
15+78.5	A	4.1	-	-	-
	B	3.0	-	-	-
	C	4.8	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+80.75	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+82.25	A	-	10.2	-	0.1
	B	3.0	9.8	Comm	0.0
	C	3.0	9.9	Comm	3.3
	D	4.7	8.1	Comm	0.5
	E	-	10.2	-	10.2
	F	4.0	8.8	-	0.8
	G	3.0	9.8	-	0.8
	H	5.0	7.8	-	4.0
	I	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
15+85.75	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
MONO A-6					
15+88.8	A	4.0	-	-	-
	B	3.0	-	-	-
	C	4.1	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+90.8	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+93	A	-	10.2	-	1.3

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	3.0	10.0	Comm	0.0
	C	3.0	9.8	14.2	0.9
	D	3.0	10.0	0.5	4.5
	E	-	10.2	-	15.8
	F	3.6	9.1	-	0.2
	G	3.0	9.9	-	0.1
	H	4.0	8.8	-	0.0
	I	-	-	-	-
15+94.5	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+97	A	4.1	-	-	-
	B	3.0	-	-	-
	C	2.1	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
15+99	A	3.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+02.5	A	-	10.2	-	0.1
	B	1.7	9.1	Comm	0.1
	C	1.3	9.1	150.0	0.1
	D	1.0	10.0	Comm	0.2
	E	-	10.2	-	1.8
	F	4.0	8.8	-	0.2
	G	1.8	10.0	-	5.6
	H	2.3	8.5	-	0.1
	I	-	-	-	-
16+05	A	3.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+08.3	A	4.5	-	-	-
	B	3.5	-	-	-
	C	4.5	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+11.3	A	3.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+13	A	-	10.2	-	0.4
	B	3.1	9.7	0.1	1.1
	C	3.0	9.8	0.0	0.0
	D	3.2	9.6	0.1	0.0
	E	-	10.2	-	16.3
	F	2.0	8.5	-	3.7
	G	3.5	9.3	-	0.2
	H	4.7	8.1	-	0.0
	I	-	-	-	-
16+16.25	A	4.0	-	-	-
	B	-	-	-	-
	C	4.0	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	I	-	-	-	-
16+18.75	A	4.3	-	-	-
	B	3.0	-	-	-
	C	4.4	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+22	A	3.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
MONO A-7					
16+24.5	A	-	10.2	-	0.0
	B	4.2	7.8	0.0	2.8
	C	4.2	7.8	0.1	0.2
	D	4.2	7.8	0.6	17.5
	E	-	10.2	-	0.0
	F	4.2	7.8	-	0.0
	G	4.2	7.8	-	0.9
	H	4.2	7.8	-	9.4
	I	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
16+26.3	A	4.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+29	A	4.2	-	-	-
	B	4.2	-	-	-
	C	4.2	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+31.5	A	4.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+33.8	A	-	10.2	-	16.6
	B	4.2	7.8	Comm	0.3

tation	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	4.2	7.8	0.6	0.2
	D	4.2	7.8	Comm	0.0
	E	-	10.2	-	0.0
	F	4.2	7.8	-	0.1
	G	4.2	7.8	-	0.2
	H	4.2	7.8	-	0.2
	I	-	-	-	-
16+36.5	A	4.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+39	A	4.2	-	-	-
	B	4.2	-	-	-
	C	4.2	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+41.5	A	4.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+43.3	A	-	10.2	-	0.3
	B	4.2	7.8	1.9	47.6
	C	4.2	7.8	Comm	0.6
	D	4.2	7.8	29.1	0.1
	E	-	10.2	-	4.4
	F	4.2	7.8	-	0.6
	G	4.2	7.8	-	0.0
	H	4.2	7.8		0.1
	I	-	-	-	-
16+46.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+49	A	3.7	-	-	-
	B	2.7	-	-	-
	C	3.7	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+51.3	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+52.8	A	-	10.2	-	0.0
	B	2.7	7.8	-	0.0
	C	3.7	7.8	-	0.1
	D	3.7	7.8	-	0.2
	E	-	10.2	-	74.2
	F	3.2	7.8	-	0.0
	G	3.2	7.8	-	37.4
	H	2.7	8.8	-	0.0
	I	-	-	-	-
16+53.8	A	2.7	-	-	-
	B	-	-	-	-
	C	2.7	-	-	-
	D	2.7	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	I	-	-	-	-
16+56	A	3.7	-	-	-
	B	4.2	-	-	-
	C	4.2	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
MONO A-8					
16+60	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+61	A	3.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
16+63.8	A	-	10.2	-	0.0
	B	3.2	7.8	-	0.0
	C	3.2	7.8	-	47.8
	D	3.2	7.8	-	0.0
	E	-	10.2	-	0.0
	F	2.7	7.8	-	0.3
	G	2.7	7.8	-	0.0
	H	2.7	7.8	-	0.7
	I	-	-	-	-
16+65	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+67.3	A	2.7	-	1.1	-
	B	2.7	-	-	-
	C	2.7	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-		
16+70	A	2.7	-	-	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+73.8	A	-	10.2	-	0.0
	B	3.2	7.8	17.4	3.8
	C	3.2	7.8	-	1.6
	D	3.2	7.8	1.4	0.2
	E	-	10.2	-	0.0
	F	2.7	7.8	-	0.0
	G	2.7	7.8	-	13.3
	H	2.7	7.8	-	-
	I	-	-	-	-
16+75	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+77.5	A	2.7	-	-	-
	B	2.7	-	-	-
	C	2.7	-	0.4	-
	D	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+80	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+83.8	A	-	10.2	-	-
	B	3.2	7.8	-	-
	C	3.2	7.8	-	Comm
	D	3.2	7.8	67.8	-
	E	-	10.2	-	-
	F	2.7	7.8	-	-
	G	2.7	7.8	-	-
	H	2.7	7.8	-	-
	I	-	-	-	-
16+84.8	A	4.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+85.5	A	3.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+87.3	A	2.7	-	-	-
	B	3.7	-	-	-
	C	2.7	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+89	A	3.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	I	-	-	-	-
16+89.5	A	1.5	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
	I	-	-	-	-
16+94	A	-	10.2	-	-
	B	3.7	6.8	-	-
	C	2.7	7.8	11.5	-
	D	2.7	7.8	0.0	-
	E	-	10.2	-	-
	F	4.2	6.8	-	-
	G	3.2	7.8	-	-
	H	4.2	6.8	-	-
16+97	A	-	-	-	-
	B	2.2	-	-	-
	C	2.2	-	-	-
	D	3.2	-	-	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+02	A	-	10.2	-	-
	B	2.2	8.8	0.0	-
	C	2.2	8.8	0.0	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	3.2	7.8	0.0	-
	E	-	10.2	-	-
	F	2.7	7.8	-	-
	G	2.7	7.8	-	-
	H	2.7	7.8	-	-
17+07	A	-	-	-	-
	B	2.2	-	0.0	-
	C	3.2	-	-	-
	D	2.2	-	95.9	-
	E	-	-	-	-
	F	3.7	-	-	-
	G	2.7	-	-	-
	H	3.7	-	-	-
17+10	A	2.7	-	-	-
	B	4.2	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+12	A	2.2	10.2	-	-
	B	2.2	8.8	1.2	-
	C	2.2	8.8	-	-
	D	2.2	8.8	0.1	-
	E	2.2	10.2	-	-
	F	3.7	6.8	-	-
	G	2.7	7.8	-	-
	H	2.7	6.8	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
17+17.8	A	-	-	-	-
	B	3.2	-	-	-
	C	3.2	-	-	-
	D	3.2	-	0.1	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+23.8	A	-	10.2	-	-
	B	3.2	7.8	0.2	-
	C	3.2	7.8	0.1	-
	D	3.2	7.8	0.1	-
	E	-	10.2	-	-
	F	2.7	7.8	-	-
	G	2.7	7.8	-	-
	H	2.7	7.8	-	-
17+24.5	A	3.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+26.8	A	2.2	-	0.7	-
	B	3.2	-	-	-
	C	3.2	-	-	-
	D	3.2	-	-	-
	E	2.2	-	0.3	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
MONO A-10					
17+29.5	A	2.2	-	-	-
	B	3.2	-	0.1	-
	C	3.2	-	2.1	-
	D	3.2	-	-	-
	E	2.2	-	0.2	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+33	A	2.2	46.8	0.3	-
	B	2.2	46.8	2.6	-
	C	2.2	44.0	-	-
	D	2.2	46.8	-	-
	E	2.2	46.8	0.2	-
	F	2.7	45.8	-	-
	G	2.7	45.8	-	-
	H	2.7	45.8	-	-
17+36	A	2.2	-	-	-
	B	2.2	-	-	-
	C	2.2	-	0.1	-
	D	2.2	-	0.1	-
	E	2.2	-	0.3	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+37.5	A	2.2	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+37.8	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+38.8	A	2.2	-	0.2	-
	B	2.2	-	0.3	-
	C	2.2	-	0.1	-
	D	2.2	-	-	-
	E	2.2	-	1.6	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+40.8	A	3.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
17+42	A	3.2	46.8	0.3	-
	B	3.2	46.8	0.2	-
	C	3.2	40.0	0.1	-
	D	3.2	46.8	0.9	-
	E	3.2	46.8	-	-
	F	2.7	45.8	-	-
	G	2.7	45.8	-	-
	H	2.7	45.8	-	-
17.45.5	A	3.2	-	4.9	-
	B	3.2	-	0.1	-
	C	3.2	-	0.1	-
	D	3.2	-	0.3	-
	E	3.2	-	0.5	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+49	A	3.2	-	1.0	-
	B	3.2	-	0.0	-
	C	3.2	-	1.0	-
	D	3.2	-	2.7	-
	E	3.2	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+52.5	A	3.2	45.8	-	-
	B	3.2	35.0	7.1	-
	C	3.2	25.0	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	3.2	45.2	0.7	-
	E	3.2	45.2	6.4	-
	F	2.7	40.0	-	-
	G	2.7	45.8	-	-
	H	2.7	45.8	-	-
17+57	A	-	-	-	-
	B	3.2	-	1.0	-
	C	3.2	-	0.0	-
	D	3.2	-	0.0	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+59	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+62	A	-	9.0	-	-
	B	3.2	7.8	-	-
	C	3.2	7.8	0.7	-
	D	3.2	7.8	0.0	-
	E	-	10.2	-	-
	F	-	7.8	-	-
	G	2.7	8.8	-	-
	H	2.7	7.8	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
17+64	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+66.5	A	-	-	-	-
	B	2.2	-	1.0	-
	C	2.2	-	-	-
	D	2.2	-	19.3	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+69.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+71.5	A	-	-	-	-
	B	2.2	8.8	2.1	-
	C	2.2	8.8	0.2	-
	D	2.2	8.8	0.2	-
	E	-	10.2	-	-
	F	2.7	7.8	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	2.7	7.8	-	-
	H	2.7	7.8	-	-
17+74.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+76.5	A	-	-	-	-
	B	2.2	-	-	-
	C	2.2	-	2.0	-
	D	2.2	-	0.0	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+79.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	_
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+81.8	A	-	10.2	-	-
	B	2.2	8.8	-	-
	C	2.2	8.8	5.1	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	2.2	8.8	0.3	-
	E	-	10.2	-	-
	F	2.7	7.8	-	-
	G	2.7	7.8	-	-
	H	2.7	7.8	-	-
17+84.3	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-+
	G	-	-	-	-
	H	-	-	-	-
17+86.8	A	-	-	-	-
	B	2.2	-	0.2	-
	C	2.2	-	-	-
	D	2.2	-	0.7	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
17+87.3	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
17+91.5	A	-	10.2	-	-
	B	2.2	8.8	Comm	-
	C	2.2	8.8	Comm	-
	D	2.2	8.8	-	-
	E	-	10.2	-	-
	F	2.7	7.8	-	-
	G	2.7	7.8	-	-
	H	2.7	7.8	-	-
17+92.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
17+97	A	-	-	-	-
	B	2.2	-	Comm	-
	C	2.2	-	0.1	-
	D	0.2	-	Comm	-
	E	-	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	1.7	-	-	-
MONO A-12					
18+00	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+02.3	A	-	10.2	-	-
	B	2.2	8.8	Comm	-
	C	2.2	8.8	0.5	-
	D	2.2	8.8	1.9	-
	E	-	10.2	-	-
	F	1.7	8.8	-	-
	G	1.7	8.8	-	-
	H	0.7	9.8	-	-
18+04.3	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+07.5	A	-	-	-	-
	B	1.2	-	Comm	-
	C	2.2	-	0.1	-
	D	2.2	-	Comm	-
	E	-	-	-	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
18+09.3	A	1.7	-	-	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+12.3	A	-	10.2	-	-
	B	1.2	9.8	0.0	-
	C	2.2	8.8	0.0	-
	D	1.2	9.8	66.9	-
	E	-	10.2	-	-
	F	1.7	8.8	-	-
	G	1.7	8.8	-	-
	H	1.7	8.8	-	-
18+15	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+17.3	A	-	-	-	-
	B	2.2	-	0.0	-
	C	2.2	-	0.0	-
	D	2.2	-	0.0	-
	E	1.7	-	-	-
	F	1.7	-	-	-
	G	1.7	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	2.7	-	-	-
18+19.5	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+21	A	-	10.2	-	-
	B	1.2	9.8	Comm	-
	C	2.2	8.8	1.7	-
	D	2.2	-	Comm	-
	E	-	10.2	-	-
	F	1.7	8.8	-	-
	G	1.7	8.8	-	-
	H	1.7	8.8	-	-
18+24.5	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+26.5	A	-	-	-	-
	B	1.2	-	Comm	-
	C	1.2	-	0.0	-
	D	1.2	-	Comm	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	-	-	-	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
18+30	A	1.7	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+30.3	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F		-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+31.3	A	1.7	-	-	-
	B	2.2	-	Comm	-
	C	2.2	-	0.0	-
	D	2.2	-	Comm	-
	E	2.2	-	-	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
MONO A-13					

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
18+33.8	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+36.3	A	2.2	-	-	-
	B	2.2	-	Comm	-
	C	2.2	-	0.0	-
	D	2.2	-	Comm	-
	E	2.2	-	0.0	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
18+38.3	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+41.3	A	2.2	-	-	-
	B	2.2	-	0.0	-
	C	2.2	-	0.0	-
	D	2.2	-	0.0	-
	E	2.2	-	0.7	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	2.2	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
18+43.3	A	0.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+46.3	A	2.2	-	-	-
	B	2.2	-	0.3	-
	C	2.2	-	0.0	-
	D	2.2	-	Comm	-
	E	2.2	-	0.7	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
18+48.8	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+51.3	A	2.2	-	-	-
	B	2.2	-	0.7	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	2.2	-	0.7	-
	D	2.2	-	0.0	-
	E	2.2	-	0.3	-
	F	2.2	-	-	-
	G	2.2	-	-	-
	H	2.2	-	-	-
18+53.3	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+56.8	A	2.2	-	-	-
	B	2.2	-	-	-
	C	2.2	-	0.1	-
	D	2.2	-	0.0	-
	E	2.2	-	0.0	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+58.3	A	2.2	-	0.5	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	-	-	-	-
18+58.8		Not	Drilled		
18+61.3	A	2.2	-	0.4	-
	B	2.2	-	0.1	-
	C	1.2	-	Comm	-
	D	2.2	-	Comm	-
	E	2.2	-	0.0	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+62.8	A	2.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	. --	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+63.3	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+64.5	A	-	18.2	11.2	-
	B	-	-	-	-
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-		
	H	-	-	-	-
18+65	A	2.2	-	0.6	-
	B	3.2	-	2.7	-
	C	2.2	-	Comm	-
	D	3.2	-	-	-
	E	3.2	-	0.1	-
	F	2.7	-	-	-
	G	Steel	-	-	-
	H	1.7	-	-	-
18+65.5	A	2.7	-	Comm	-
	B	1.2	-	-	-
	C	1.2	-	Comm	-
	D	1.2	-	Comm	-
	E	1.2	-	Comm	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
18+68	A	2.0	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
18+70.5	A	-	18.2	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+71	A	2.2	-	0.6	-
	B	2.2	-	0.6	-
	C	2.2	-	Comm	-
	D	2.2	-	0.0	-
	E	2.2	-	0.1	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
18+73.3	A	2.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+73.5	A	2.0	18.2	0.1	-
	B	2.7	-	0.7	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+76.5	A	2.2	-	0.1	-
	B	2.2	-	Comm	-
	C	2.2	-	9.1	-
	D	2.2	-	0.0	-
	E	2.2	-	0.1	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
18+78.3	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+78.5	A	2.2	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+81	A	2.2	-	0.1	-
	B	2.2	-	0.1	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	2.2	-	0.1	-
	D	2.2	-	0.3	-
	E	2.2	-	0.0	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
18+82	A	2.0	-	-	-
	B	2.2	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+82.5	A	1.7	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+85.5	A	2.2	-	0.0	-
	B	2.0	-	-	-
	C	2.2	-	Comm	-
	D	2.2	-	0.1	-
	E	2.2	-	0.1	-
	F	2.7	-	-	-
	G	2.7	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	2.7	-	-	-
18+87.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+91	A	2.2	-	0.0	-
	B	2.2	-	0.0	-
	C	2.2	-	0.0	-
	D	2.2	-	-	-
	E	2.2	-	0.0	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
18+92.3	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
18+95.8	A	2.2	-	Comm	-
	B	2.2	-	0.0	-
	C	2.2	-	Comm	-
	D	2.2	-	0.1	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	E	2.2	-	0.1	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
18+97.5	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+00.8	A	2.2	-	0.1	-
	B	MISSING			
	C	2.2	-	0.1	-
	D	2.2	-	0.1	-
	E	2.2	-	0.1	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
19+01.8	A	2.2	-	-	-
	B	-	-	0.1	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+04.5	A	2.2	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	2.2	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+04.7	A	-	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+06.5	A	2.2	-	0.1	-
	B	2.2	-	0.1	-
	C	2.2	-	Comm	-
	D	2.2	-	-	-
	E	2.2	-	0.3	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
19+09.5	A	2.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-		-	-
	E	-		-	-
	F	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	-	-	-	-
	H	-	-	-	-
19+11.5	A	2.2	-	0.0	-
	B	2.2	-	10.9	-
	C	2.2	-	39.2	-
	D	2.2	-	0.0	-
	E	2.2	-	0.1	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
19+15	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+17.5	A	2.2	-	0.3	-
	B	2.2	-	1.0	-
	C	2.2	-	0.0	-
	D	2.2	-	Comm	-
	E	2.2	-	0.0	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
19+19.5		Not Drilled			
19+21.5	A	2.2	-	1.4	-
	B	2.2	-	0.0	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	2.2	-	0.0	-
	D	2.2	-	0.0	-
	E	2.2	-	0.0	-
	F	2.7	-	-	-
	G	2.7	-	-	-
	H	2.7	-	-	-
19+24	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+26	A	2.2	-	0.0	-
	B	2.2	-	0.7	-
	C	2.2	-	0.0	-
	D	2.2	-	0.1	-
	E	2.2	-	0.0	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
19+28.5	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
19+31	A	2.2	-	0.0	-
	B	2.2	-	5.7	-
	C	2.2	-	0.0	-
	D	2.2	-	Comm	-
	E	2.2	-	1.4	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
19+32	A	2.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+33.5	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+36	A	1.7	-	1.4	-
	B	1.7	-	0.0	-
	C	1.7	-	Comm	-
	D	2.2	-	49.0	-
	E	2.2	-	0.3	-
	F	1.7	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	G	1.7	-	-	-
	H	1.7	-	-	-
19+38	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+40	A	2.2	-	0.0	-
	B	2.2	-	0.6	-
	C	2.2	-	0.0	-
	D	2.2	-	0.0	-
	E	2.2	-	0.1	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
19+40.3	A	2.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
MONO A-16					
19+43	A	1.7	-	-	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+43.5	A	2.2	-	14.1	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+45	A	2.2	-	0.1	-
	B	2.2	-	Comm	-
	C	1.0	-	0.0	-
	D	Not Drilled			
	E	1.7	-	0.0	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
19+47.5	A	1.7	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	H	-	-	-	-
19+48.3	A	2.2	-	-	-
	B	-	-	-	-
	C	-	-	-	-
	D	-	-	-	-
	E	-	-	-	-
	F	-	-	-	-
	G	-	-	-	-
	H	-	-	-	-
19+49	A	2.2	-	0.1	-
	B	2.2	-	0.1	-
	C	2.2	-	Comm	-
	D	2.2	-	0.0	-
	E	2.2	-	0.0	-
	F	1.7	-	-	-
	G	1.7	-	-	-
	H	1.7	-	-	-
19+50.5		Not Drilled			
MONO A-17					
19+54.5	A	2.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
19+59.5	A	2.2	-	179.9	-
	B	2.2	-	0.1	-
	C	2.2	-	0.1	-
19+60	A	2.2	-	-	-
	B	-	-	-	
	C	-	-	-	-
19+66	A	-	-	0.1	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
19+69	A	2.2	-	0.1	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
19+71	A	2.2	-	4.8	-
	B	-	-	-	
	C	-	-	-	-
19+75	A	2.2	-	1.4	-
	B	-	-	-	-
	C	-	-	-	-
19+79	A	2.2	-	0.1	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
19+81	A	2.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
MONO A-18					
19+87.5	A	2.2	-	0.0	-
	B	-	-	-	0
	C	-	-	-	-
19+89.5	A	2.2	-	Comm	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
19+93.5	A	2.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
19+99.5	A	2.2	-	Comm	-
	B	2.2	-	Comm	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	2.2	-	0.8	-
20.03	A	2.2	-	4.5	-
	B	-	-	-	-
	C	-	-	-	-
20.09.5	A	2.2	-	Comm	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
	D	2.2	-	Comm	-
20.13	A	2.2	-	0.3	-
	B	-	-	-	-
	C	-	-	-	-
20.19		Missing			
20.19.5	A	2.2	-	Comm	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
MONO A-19					
20+22	A	2.2	-	0.7	-
	B	-	-	-	-
	C	-	-	-	-
20.28.5	A	2.2	-	Comm	-
	B	2.2	-	4.3	-
	C	2.2	-	9.1	-
20+33.5	A	2.2	-	0.3	-
	B	-	-	-	-
	C	-	-	-	-
20+38.5	A	2.2	-	Comm	-
	B	2.2	-	0.1	-
	C	2.2	-	6.6	-
20+43.5	A	2.2	-	371.7	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
20+49	A	2.2	-	Comm	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
MONO A-20					
20+59	A	1.2	-	0.3	-
	B	1.2	-	0.3	-
	C	1.2	-	0.0	-
20+61.5	A	1.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
20+69	A	1.2	-	Comm	-
	B	1.2	-	0.3	-
	C	1.2	-	0.0	-
20+75	A	1.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
20+78	A	1.0	-	0.0	-
	B	1.0	-	0.0	-
	C	1.2	-	0.0	-
20+82	A	1.0	-	0.3	-
	B	-	-	-	-
	C	-	-	-	-
20+84.5	A	1.8	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
20+85.5	A	3.7	-	0.0	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
20+87.5	A	1.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
20+89	A	1.7	-	0.3	-
	B	1.7	-	0.3	-
	C	1.2	-	0.3	-
MONO A-21					
20+92	A	2.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
20+97	A	2.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
20+99	A	1.2	-	0.0	-
	B	1.2	-	0.0	-
	C	1.7	-	0.0	-
21+09	A	1.2	-	0.0	-
	B	3.5	-	1.5	-
	C	1.2	-	6.4	-
21+17.5	A	1.7	-	35.6	-
	B	-	-	-	-
	C	-	-	-	-
21+19	A	2.2	-	Comm	-
	B	1.2	-	0.6	-
	C	1.2	-	Comm	-
MONO A-22					
21+30.5	A	1.2	-	2.8	-
	B	1.7	-	2.6	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	1.2	-	0.1	-
21+40.5	A	1.2	-	18.2	-
	B	1.2	-	0.1	-
	C	1.2	-	0.1	-
21+51.5	A	1.2	-	Comm	-
	B	1.2	-	4.2	-
	C	1.2	-	0.0	-
MONO A-23					
21+62	A	1.2	-	15.0	-
	B	1.2	-	0.3	-
	C	1.2	-	Comm	-
21+71	A	1.2	-	0.1	-
	B	1.2	-	0.1	-
	C	1.2	-	0.1	-
21+81.5	A	1.2	-	3.2	-
	B	1.7	-	7.6	
	C	1.2	-	0.1	-
21+90.5	A	2.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
21+91.5	A	1.7	-	Comm	-
	B	1.2	-	0.3	-
	C	1.2	-	0.1	-
MONO A-24					
21+96.5	A	1.2	-	74.5	-
	B	-	-	-	-
	C	-	-	-	-
21+98	A	1.2	-	0.0	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
22+00.5	A	1.2	-	Comm	-
	B	1.2	-	0.3	-
	C	1.2	-	Comm	-
22+10.5	A	1.2	-	Comm	-
	B	2.2	-	2.0	-
	C	1.2	-	0.1	-
22+14.5	A	2.2	-	0.6	-
	B	-	-	-	-
	C	-	-	-	-
22+20.5	A	2.2	-	Comm	-
	B	2.2	-	7.5	-
	C	-	-	-	-
22+21.5	A	2.2	-	1.0	-
	B	-	-	-	-
	C	2.2	-	Comm	-
MONO A-25					
22+32	A	1.2	-	0.0	-
	B	1.2	-	12.8	-
	C	1.2	-	Comm	-
22+42	A	1.2	-	0.0	-
	B	1.2	-	0.0	-
	C	1.2	-	0.3	-
22+51	A	2.2	-	0.0	-
	B	2.2	-	37.8	-
	C	2.2	-	3.4	-
	D	2.2	-	30.7	-
22+58	A	3.2	-	0.0	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
22+62.8	A	2.2	-	0.3	-
	B	2.2	-	125.3	-
	C	2.2	-	Comm	-
22+63.8	A	2.2	-	0.3	-
	B	-	-	-	-
	C	-	-	-	-
MONO A-26					
22+69	A	3.2	-	3.2	-
	B	-	-	-	-
	C	-	-	-	-
22+72.5	A	1.2	-	0.0	-
	B	1.2	-	0.0	-
	C	2.2	-	Comm	-
22+74.5	A	2.2	-	3.0	-
	B	-	-	-	-
	C	-	-	-	-
22+77	A	3.2	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
22+82	A	1.2	-	Comm	-
	B	1.2	-	28.9	-
	C	1.2	-	0.3	-
22+86	A	2.2	-	120.3	-
	B	-	-	-	-
	C	-	-	-	-
22+90	A	3.2	-	2.0	-
	B	-	-	-	-
	C	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
22+92.8	A	2.2	-	Comm	-
	B	2.2	-	Comm	-
	C	2.2	-	Comm	-
22+96.3	A	2.2	-	0.3	-
	B	-	-	-	-
	C	-	-	-	-
MONO A-27					
23+04	A	1.2	-	0.0	-
	B	1.2	-	0.0	-
	C	1.2	-	0.0	-
23+07.5	A	3.2	-	8.4	-
	B	-	-	-	-
	C	-	-	-	-
23+15	A	2.2	-	Comm	-
	B	1.7	-	0.3	-
	C	2.2	-	Comm	-
23+17	A	2.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
23+24	A	2.2	-	7.4	-
	B	2.2	-	0.0	-
	C	-	-	-	-
23+25	A	1.2	-	Comm	-
	B	2.2	-	4.7	-
	C	-	-	-	-
23+32	A	3.2	-	0.0	-
	B	3.2	-	481.5	-
	C	-	-	-	-
23+35	A	2.2	-	Comm	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	2.2	-	0.0	-
	C	2.2	-	Comm	-
MONO A-28					
23+39	A	3.2	-	0.0	-
	B	3.2	-	0.0	-
	C	-	-	-	-
23+45	A	2.2	-	Comm	-
	B	2.2	-	0.0	-
	C	2.2	-	Comm	-
23+53	A	3.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
23+55	A	3.2	-	Comm	-
	B	2.2	-	0.0	-
	C	1.2	-	Comm	-
23+64	A	2.2	-	Comm	-
	B	2.2	-	0.0	-
	C	1.2	-	Comm	-
23+65	A	2.2	-	Comm	-
	B	2.2	-	0.0	-
	C	1.2	-	Comm	-
MONO A-29					
23+75	A	1.2	-	Comm	-
	B	1.2	-	0.0	-
	C	1.2	-	0.1	-
23+83	A	1.2	-	4.4	-
	B	-	-	-	-
	C	-	-	-	-
23+84	A	3.2	-	Comm	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	-	-	-	-
23+85	A	1.2	-	0.0	-
	B	1.2	-	0.1	-
	C	1.2	-	0.0	-
23+95	A	1.2	-	0.1	-
	B	1.2	-	0.1	-
	C	1.2	-	0.6	-
24+04	A	1.2	-	8.6	-
	B	1.2	-	0.0	-
	C	1.2	-	Comm	-
MONO A-30					
24+08	A	2.2	-	0.8	-
	B	-	-	-	-
	C	-	-	-	-
24+12.5	A	3.2	-	24.7	-
	B	-	-	-	-
	C	-	-	-	-
24+15.5	A	1.2	-	0.1	-
	B	2.2	-	0.1	-
	C	1.2	-	Comm	-
24+17.5	A	4.2	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
24+23	A	4.2	-	201.3	-
	B	-	-	-	-
	C	-	-	-	-
24+25.5	A	1.2	-	Comm	-
	B	1.2	-	0.0	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	1.2	-	0.0	-
24+26	A	1.2	-	Comm	-
	B	1.2	-	0.0	-
	C	1.2	-	0.0	-
24+36	A	1.2	-	0.3	-
	B	1.2	-	1.0	-
	C	1.2	-	Comm	-
24+40	A	3.2	-	0.7	-
	B	-	-	-	-
	C	-	-	-	-
MONO A-31					
24+45.5	A	2.2	-	0.0	-
	B	2.2	-	0.0	-
	C	3.2	-	Comm	-
24+51.3		Missed			
24+55	A	3.2	-	35.1	-
	B	3.2	-	0.7	-
	C	2.2	-	Comm	-
24+55AA	A	2.2	-	8.8	-
	B	-	-	-	-
	C	-	-	-	-
24+65	A	1.2	-	0.7	-
	B	1.2	-	7.1	-
	C	1.2	-	0.0	-
MONO A-32					
24+77.5	A	1.2	-	0.0	-
	B	1.2	-	160.1	-
	C	1.2	-	1.6	-
23+85	A	2.2	-	Comm	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	B	-	-	-	-
	C	1.2	-	Comm	-
24+87.5	A	2.2	-	Comm	-
	B	2.2	-	0.3	-
	C	2.2	-	Comm	-
24+97.5	A	1.2	-	Comm	-
	B	1.2	-	46.0	-
	C	0.7	-	Comm	-
25+00	A	2.2	-	18.2	-
	B	-	-	-	-
	C	-	-	-	-
25+05.5	A	1.7	-	1.7	-
	B	-	-	-	-
	C	-	-	-	-
25+06.5	A	1.2	-	0.1	-
	B	1.2	-	0.0	-
	C	1.2	-	0.1	-
MONO A-33					
25+12	A	2.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
25+18	A	1.2	-	Comm	-
	B	1.2	-	0.0	-
	C	1.2	-	0.0	-
25+21.5	A	2.2	-	21.0	-
	B	-	-	-	-
	C	-	-	-	-
25+27.5	A	1.2	-	Comm	-
	B	1.2	-	0.0	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	1.2	-	Comm	-
25+37	A	1.2	-	Comm	-
	B	1.2	-	0.1	-
	C	1.2	-	0.1	-
25+38	A	1.7	-	0.1	-
	B	-	-	-	-
	C	-	-	-	-
MONO A-34					
25+48	A	1.7	-	30.8	-
	B	1.2	-	0.1	-
	C	1.2	-	Comm	-
25+49	A	1.2	-	0.0	-
	B	-	-	-	-
	C	-	-	-	-
25+57.5	A	1.2	-	Comm	-
	B	-	-	-	-
	C	-	-	-	-
25+58.5	A	1.2	-	Comm	-
	B	1.2	-	0.7	-
	C	1.2	-	Comm	-
25+69.5	A	1.2	-	9.5	-
	B	1.2	-	0.1	-
	C	1.2	-	Comm	-
25+79	A	1.2	-	0.1	-
	B	1.2	-	6.4	-
	C	1.2	-	0.6	-
MONO A-35					
25+87	A	2.2	-	5.3	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
25+88.5	A	1.2	-	Comm	-
	B	1.2	-	20.9	-
	C	1.2	-	Comm	-
25+94	A	1.2	-	2.7	-
	B	-	-	-	-
	C	-	-	-	-
25+96	A	1.2	-	2.7	-
	B	1.2	-	Comm	-
	C	-	-	-	-
25+98.5	A	1.2	-	0.0	-
	B	1.2	-	0.3	-
	C	2.2	-	Comm	-
26+07.5	A	2.2	-	0.0	-
	B	Missed			
	C	3.2	-	Comm	-
26+08.5	A	1.2	-	4.1	-
	B	1.2	-	46.3	-
	C	-	-	-	-
MONO A-36					
26+18.5	A	1.2	-	0.0	-
	B	1.2	-	0.0	-
	C	1.2	-	Comm	-
26+23	A	2.2	-	1.7	-
	B	-	-	-	-
	C	-	-	-	-
MONO A-37					
26+26.5	A	3.2	-	0.0	-
	B	-	-	-	-

Station	Hole	Drill Contact	Drilling Consolidation	Grout Contact	Grouting Consolidation
	C	-	-	-	-
26+28	A	1.7	-	3.7	-
	B	3.2	-	0.0	-
	C	-	-	-	-

APPENDIX 1

OFFICE REPORT

The AGE OF FAULTS in the RESERVOIR BORROW AREA - LITTLE DELL DAM, UTAH

INCLUDING:

APPENDIX A: BORROW AREA GEOLOGIC STRUCTURE STUDY

APPENDIX B: ESTIMATED AGE OF LATE QUATERNARY FLUVIAL CHANNELS

US Army Corps
of Engineers
Sacramento District

APRIL 1993

THE AGE OF FAULTS in the RESERVOIR BORROW AREA
LITTLE DELL DAM, UTAH

April 1993

TABLE OF CONTENTS

1. Executive Summary 1
2. Introduction 1
3. Pre-Construction Investigations 2
4. Construction Investigations 3
5. 1990 USGS Geologic Map 4
6. Tectonic Implications 5
7. Quaternary Fault Capability 6
8. Fluvial Stratigraphy of the Reservoir Borrow Area 7
9. Stratigraphic Age Assessments 10
10. Radiocarbon Dating 12
11. Paleontological Age Assessments 13
12. Conclusions 13
13. References 15

ILLUSTRATIONS

Figure 1	General Map
Figure 2	Geologic Map
Figure 3	Borrow Area Location Map
Figure 4	Log of Trench FT-3
Figure 5	Areal Extent of Fluvial Cycle - 1 Channel Deposits
Figure 6	Areal Extent of Fluvial Cycle - 2 Channel Deposits
Figure 7	Areal Extent of Fluvial Cycle - 3 Channel Deposits
Figure 8	Areal Extent of Fluvial Cycle - 4 Channel Deposits
Figure 9	Generalized Longitudinal Section A-A'
Figure 10	Generalized Cross Section B-B'
Figure 11	Generalized Cross Section C-C'
Figure 12	Generalized Cross Section D-D'

ATTACHMENTS

Photographs	(2 Sheets)
Appendix A	Borrow Area Geologic Structure Study, Little Dell Dam, Utah
Appendix B	Estimated Age of Late Quaternary Fluvial Channels, Reservoir Borrow Area, Little Dell Dam, Utah - Roy J. Shlemon & Assoc., Inc.

THE AGE OF FAULTS in the RESERVOIR BORROW AREA
LITTLE DELL DAM, UTAH

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Sacramento, California

April 1993

1. **Executive Summary**. During excavation of the Little Dell Dam reservoir borrow area between June and August 1992, three (3) discrete faults (informally designated by location upstream from Little Dell Dam as at sites A, B, and C, respectively) were exposed. The faults were associated with "steps" or offsets in bedrock of the Cretaceous age Frontier Formation and coincided with sheared and faulted bedding planes. The faults exhibit a reverse sense of movement, typical of displacements produced by regional compression associated with the initial formation and uplift of the Wasatch Range. These mountain-building compressional forces generally ended about 25 million years ago; however, the reservoir faults have locally displaced the overlying alluvium in the lowest (oldest) of four (4) cycles of fluvial channel deposits and appear to extend upward into the basal gravel of the third (the next younger) channel deposit. Based on local paleontological assessments, on regional climatic and stratigraphic interpretation, and on site-specific radiocarbon dates accepted with qualifications as stated in this report, the last movement of the reservoir faults at sites A, B and C took place prior to at least 60,000 to 70,000 years ago and most likely prior to 100,000 years ago. In accordance with Corps of Engineers active (capable) fault criteria requiring displacement within the last 35,000 years, none of the three reservoir borrow area faults are capable and, therefore, do not impact the design or construction of Little Dell Dam.

2. **Introduction**. Little Dell Dam is located in Mountain Dell Canyon of the Wasatch Mountains, about 10 miles (16 km) due east of Salt Lake City, Utah (see General Map, Figure 1). The dam impounds water from Dell Creek, a tributary of Parleys Creek, about 1-mile upstream from Mountain Dell Dam. The site is within the western boundary of

the Rocky Mountain geomorphic province about 8 miles (13 km) east of the Wasatch fault and lies upon the western flank of the Parleys Canyon Syncline. Immediately northwest of the dam, the Parleys Canyon Syncline is in fault contact with the Emigration Canyon Syncline along the Little Mountain fault (referred to herein as a zone). Reverse movement on the Little Mountain fault zone (see Figure 2) has juxtaposed the two synclines cutting out the intervening anticline. The episodes of folding and thrust faulting which created these structural relationships are believed to be associated with regional compressional forces in effect during Wasatch Range mountain-building orogenies which ended about 25 million years before present (Stokes, 1987). Since that time the regional stress regime has been mainly tensional, resulting in normal faulting such as exhibited along the present-day Wasatch fault zone and the East Canyon fault (northeast of Little Dell Dam).

3. **Pre-Construction Investigations**. The site of Little Dell Dam has been under investigation since 1951 with engineering studies and exploration work accomplished by the following organizations and sponsors:

- 1951 - Dr. Ray E. Marsell. Sponsor: Salt Lake City Corporation.

- 1954 to present - U.S. Army Corps of Engineers. Sponsor: Metropolitan Water District of Salt Lake City.

- 1962 - Berger and Associates and Dames and Moore. Sponsor: Metropolitan Water District of Salt Lake City.

- 1985 - Bingham Engineering and PRC Engineering. Sponsors: Salt Lake County Flood Control, Salt Lake City Department of Public Utilities, Metropolitan Water District of Salt Lake City, and Utah Division of Water Resources.

Based on these studies it was known that shears and faults coincident with bedding planes exist within the Cretaceous-age Kelvin and Frontier Formations at the damsite and the surrounding area. It was, therefore, logically assumed that these faults resulted from regional compressional folding and faulting which ended about 25 million years before present (b.p).

4. **Construction Investigations**. In June 1988, at the start of the core trench excavation for the dam, no late Tertiary or Quaternary normal faults were known to have been reported at or near the damsite. The closest known fault was the Little Mountain fault, about 3/4-mile to the northwest. As construction proceeded, nearly all the faults encountered in the core trench excavation were bedding plane faults and none of them offset the overlying Quaternary fluvial channel deposits exposed in the slopes of the excavation.

In June 1992, however, two (2) bedrock steps coincident with bedding plane faults in the Frontier Formation and having a hanging-wall-up (reverse) sense of movement were encountered during the Contractor's excavations in the reservoir borrow area. The Corps of Engineers (CoE) project personnel immediately began exploring these features, beginning with trenches designated as FT-1, FT-2 and FT-3 (see Figure 3, Borrow Area Location Map for the trench locations and Appendix A, *Borrow Area Geologic Structure Study*, for the trench logs). In late August 1992, additional borrow excavations revealed a third and similar bedrock step in the Frontier Formation at the location shown as trench FT-10. These three (3) separate sites where bedding plane faults were investigated are labeled A, B and C, each circled, on Figure 3.

A total of 25 trenches were excavated along the trends of the bedrock steps in order to better define the features as to their extent and stratigraphic relationships. Detailed logging of these trenches was conducted by a Little Dell staff geologist, Brian A. Bryant, under the supervision of Little Dell Project Geologist, Carl E. Cole. In addition to CoE personnel, with the trenches open and logged, inspection teams from the

Utah Geological Survey (UGS), Utah Department of National Resources, Safety of Dam Section (USDS) and the United States Bureau of Reclamation (USBR) visited the site and observed the findings.

5. **1990 USGS Geologic Map**. In 1990 the United States Geological Survey (USGS) published a regional geologic map (Bryant, 1990) that included the Little Dell Dam and reservoir area. This map shows the basic geology of the damsite area largely unchanged from published pre-construction data; however, significant changes were made in the location and extent of the mapped faults. For example, the Little Mountain fault, previously shown as a single trace about 3/4-mile northwest of the dam, is shown on the Bryant (1990) map as a fault zone with several splays. One splay (shown on Figure 3) projects southward to within 1/2-mile of the dam, and very possibly follows a deep gully and passes through the dam foundation at approximately dam axis Station 21+40. Such bedrock faults (including other faults of random orientations) were observed during the excavation of the dam core trench, but are documented as neither displacing nor otherwise disturbing the suite of overlying Quaternary channel deposits.

In addition to the fault splay noted above, an inferred (dotted) fault is shown on the 1990 map (see Figure 2). This inferred fault traverses the damsite in a northeasterly direction, about N.65°E. and follows Mountain Dell Canyon northward to the Little Mountain fault zone. During construction of Little Dell Dam, numerous bedding plane faults were documented in the dam foundation striking about N.23°E. to N.24°E. Also, the strike of bedding was seen to become gradually more easterly throughout the project area. It varied from about N.20°E. on the right abutment of the dam to about N.35°E. in the upper end of the reservoir area (these changes in strike are noted for Sites A, B and C on Figure 3). However, the inferred fault was not observed within the reservoir area.

The CoE findings were discussed with Mr. Bryant (telephone communication with Mr. Robert L. Treat, 9 December 1992). Mr. Bryant was asked what evidence he used to infer the fault and, if it exists, how old would he judge it to be. He stated that one

reason to infer this fault at the damsite was because he interpreted the Frontier Formation to be cut-off at Dell Creek and not to continue to the west across the valley. However, many of the CoE trenches excavated to investigate the bedrock steps in the reservoir area encountered the Frontier Formation beneath the Quaternary channel deposits. Because there was no major offset noted along the Kelvin/Frontier Formation contact (which is continuous along strike throughout the dam foundation and projects upstream toward the right abutment side of the reservoir) and because the Frontier Formation was mapped in trenches west of Dell Creek, it appears that the inferred fault (Bryant, 1990) does not exist.

Mr. Bryant also stated during the same discussion that another reason for inferring the presence of a fault was to explain the apparent differential offset of the Paleocene-Eocene age Wasatch Conglomerate (about 35 million years b.p.) at a distance of about 1 to 2 miles (1.6 to 3.2 km) upstream from the dam across Mountain Dell Canyon. If this offset truly exists, it could be reasonably explained by projecting another short fault splay southward from the Little Mountain fault zone, part way down the canyon.

Regarding the age of the inferred fault, Mr. Bryant stated he never considered it to be geologically young, but only that it is younger than the Wasatch Conglomerate, and that movement may have occurred in late Tertiary to early Quaternary time based on the presence of a large graben structure to the northeast.

6. <u>Tectonic Implications</u>. Although Bryant's (1990) inferred fault could not be verified by CoE investigations, the fact remains that fluvial channel deposits overlying the three (3) bedrock steps in the Frontier Formation, appeared to be affected by fault movement. The typical deformation seen is mainly in the form of horizontally-deposited materials that are now distorted to stand near-vertical and parallel to the bedrock step. The trench log of FT-3 (see Figure 4) is the best documented example of this type of deformation. Assuming that some of the fluvial channel gravel and locally preserved overbank deposits were disturbed by fault movement, then such displacement must have occurred more

recently than 25 million years b.p., and most likely in Quaternary time.

7.0 Quaternary Fault Capability. From a regional standpoint, Quaternary fault movement has now been documented by others. Specifically, the USBR (1988a) reports that Quaternary-age offsets (normal sense of movement) took place at least 100,000 years b.p and possibly more than 200,000 years ago on the East Canyon fault about 11 miles (18 km) northeast of Little Dell Dam. The East Canyon fault extends from near East Canyon Dam southward about 6 miles (10 km) toward the Little Mountain fault zone and the Little Dell Dam (see Figure 2).

The Corps of Engineers has specific criteria (Engineering Technical Letter 1110-2-301, dated 26 August 1983) defining whether Quaternary faults are to be considered capable of generating an earthquake and are therefore active in regard to the design of engineered structures. Two of these criteria are:

- "Movement at or near the ground surface at least once within the past 35,000 years."

- "A structural relationship to a capable fault such that movement on one fault could be reasonably expected to cause movement on the other."

Based on these criteria, neither the East Canyon fault (normal sense of movement) nor the Little Mountain fault zone (reverse sense of movement), even if structurally continuous, are considered to be capable faults by CoE criteria. Further, it did not appear likely that the bedrock steps and associated faults had experienced any movement more recent than 35,000 years b.p., owing to their stratigraphic position and to the lack of any displacement in the overlying deep Quaternary deposits exposed in the core trench excavation at the dam. However, for conservatism, the Sacramento District undertook additional investigations to ascertain, to the best extent possible, a minimum age for the fault displacement observed in the reservoir borrow area.

8. **Fluvial Stratigraphy of the Reservoir Borrow Area**. All pre-construction engineering studies had broadly grouped the fluvial channel deposits within the reservoir area adjacent to Dell Creek under the headings of younger and older alluvium. Prior to the discovery of the bedrock steps, these stratigraphic sequences were substantially excavated and used in the construction of Little Dell Dam. Therefore, only partial Quaternary stratigraphy remained overlying the bedrock steps by the time of their exposure. However, construction surveys of borrow area materials used for preparing volume calculations, and pre-construction explorations along with additional explorations accomplished during construction, were available. These data, originally obtained for engineering purposes, were re-analyzed in November and December 1992 and resulted in the development of significant stratigraphic information.

Four (4) discrete cycles of fluvial channel deposition were identified within the reservoir borrow area. Typically, each depositional sequence consisted of a coarse basal unit containing gravel, cobbles and boulders, often to 4-foot-diameter (1.2-meter). These basal units were overlain by alluvium which generally became finer grained the higher their stratigraphic position (hereafter referred to as fining-upward). The fine-grained sediments were primarily sand, silt and clay. These laterally-extensive, fining-upward gravel and overbank deposits most likely were laid down in response to regional changes in climate and sedimentation recorded by alternating glacial and interglacial deposits and soils identified in much of Utah (see summaries in USBR, 1988a and b). For the purpose of this report these fluvial channel depositional cycles are designated 1 through 4 with Fluvial Cycle 1 being the youngest recognized in the reservoir area and progressing downward through Fluvial Cycle 4, the oldest. The inferred climatic-stratigraphic age assessments are summarized in Appendix B (Shlemon, 1993).

- **Fluvial Cycle 1**: These deposits lie beneath and adjacent to the active stream channel and form the broad (approximately 400 to 500-foot-wide) floodplain which is continuous throughout Mountain Dell Canyon (see Photograph 1). In previous reports, these deposits were generally

designated as Quaternary Alluvium (Qal). The reconstructed areal extent of these deposits within the reservoir area prior to borrow excavation and removal is shown on Figure 5.

- **Fluvial Cycle 2**: These sediments form the second youngest sequence of fining-upward channel deposits, and were seen as a high terrace surface in the reservoir area (see Photographs 1 and 2). In the vicinity of the dam, this terrace is approximately 40 feet higher in elevation than the Fluvial Cycle 1 floodplain. Much of this terrace surface was actively farmed prior to construction of the dam. The reconstructed areal extent of Fluvial Cycle 2 within the reservoir area prior to borrow excavation and removal is shown on Figure 6.

- **Fluvial Cycle 3**: These sediments form the third oldest sequence of fining-upward channel deposits. They overlie bedrock of the Kelvin and Frontier Formations in the vicinity of the dam but are underlain by Fluvial Cycle 4 deposits in the upper portion of the reservoir area. These deposits had the greatest areal extent within the reservoir area prior to borrow excavation and removal and are shown on Figure 7. It is probable that the coarse basal portion of this cycle contains some gravel, cobbles and boulders that were eroded from Fluvial Cycle 4 and were reworked by stream action to now be contained within Fluvial Cycle 3.

- **Fluvial Cycle 4**: These deposits are the oldest sequence of fining-upward channel deposits recognized. They are not found in the vicinity of the main dam, but overlie bedrock of the Frontier Formation in the upper portion of the reservoir area. Their reconstructed areal extent within the reservoir area prior to borrow excavation and removal is shown on Figure 8. These deposits are not found as extensively throughout the reservoir area as the other fluvial cycles, as they were apparently eroded

downstream during Fluvial Cycle 3 basal gravel deposition. Fluvial Cycle 4 also appears to have been deposited more towards the northwest side of the valley rather than directly under the modern channel of Dell Creek.

After the four (4) fluvial cycles were delineated, Longitudinal Section A-A' (Figure 9) and Cross Sections B-B', C-C' and D-D' (Figures 10, 11 and 12) were prepared. Longitudinal Section A-A' connects areas having significant thicknesses of Fluvial Cycles 2, 3 and 4, but attempts to avoid interference by the interfingering of alluvial fan deposits located to the northwest. Cross Sections B-B', C-C' and D-D' show the extent of and relationships between all four (4) fluvial cycles.

The distinction between the fluvial cycles becomes less distinct from approximately Stations 59+50 through 74+00 as seen on the far upstream end of Section A-A'. This probably results from Mountain Dell Canyon having a much steeper gradient north of this point and a greater stream-load carrying capacity. Therefore, the heavier coarse materials rapidly settle-out and deposit near the gradient change, whereas the fines are transported farther downstream. If a significant thickness of the fining-upward portions of the fluvial channel deposits did exist in this area they may also have been more subject to removal by erosion owing to the narrower valley width along this reach of Dell Creek.

The following interpretations are based on Longitudinal Section A-A':

- Three (3) of the four (4) fault traces are associated with bedrock lows (or bedrock steps) at or near the point where the traces intersect or are projected to intersect Longitudinal Section A-A'. In fact, a fourth bedrock low on the section is not associated with a known bedrock fault but may indicate one that was undetected.

- The bedrock lows shown on the longitudinal section are overlain by

Fluvial Cycle 4 channel deposits, the oldest Quaternary-age sediments preserved.

• The gradient of Fluvial Cycle 4 is irregular because of undulations in the bedrock topography and not typical of normal fluvial cycle gradients such as evidenced on the longitudinal section by Fluvial Cycle 3 and Fluvial Cycle 2. This indicates that either the Fluvial Cycle 4 channel deposits were not delineated sufficiently by the explorations to show their actual depositional gradient or that the deposits have been disturbed by fault movement.

• The intersection of the fault trace defined by trenches FT-10, FT-11 and FT-12 (Fault site A, Figure 3) is neither associated with a bedrock low nor with Fluvial Cycle 4 deposits.

• Although Fluvial Cycle 3 channel deposits on Longitudinal Section A-A' appear unaffected by any of the fault traces, trench logs for FT-6, and FT-18 through 23 (see Appendix A) indicate shearing and apparent warping in the fining-upward portion of Fluvial Cycle 4; and trench logs of FT-1, 2, 6, 7. 10, 12, 14, 15, and 17 indicate small bedrock displacements (generally not more than several inches but in two instances possibly as much as 5 to 6 feet (1.5 to 1.9 meters)), all of which are overlain by the basal gravel of Fluvial Cycle 3.

These data and interpretations thus indicate that the last movement associated with the bedrock-step faults at sites A, B and C took place prior to deposition of Fluvial Cycle 2, but probably occurred in early Fluvial Cycle 3 time.

9. <u>Stratigraphic Age Assessment</u>. The four cycles of fluvial channel deposition recognized within the reservoir borrow area were most likely laid down during discrete

epochs of regional sedimentation which correspond to world-wide cycles of glaciation, each separated by a substantial interglacial period of relative landscape stability and soil formation. These glacial periods and the associated sedimentation can be approximately correlated with sea-level changes and hence dated by the marine oxygen-isotope stage chronology (Shlemon, 1985, and 1993 - Appendix B). Conservatively assuming that each of the four recognized major cycles of deposition in the reservoir area are successive and that there are no missing cycles to imply even greater antiquity, then minimum stratigraphic age estimates for Fluvial Cycles 1 through 4 are as follows in Table 1:

Table 1. *Minimum Stratigraphic Age Estimates*

BASAL GRAVEL OF		ESTIMATED AGE RANGE	O^{18}/O^{16} STAGES*
• **Fluvial Cycle 1**	-	12,000 to 20,000 years b.p.	Stage 2
• **Fluvial Cycle 2**	-	60,000 to 70,000 years b.p.	Stage 4
• **Fluvial Cycle 3**	-	130,000 to 200,000 years b.p.	Stage 6
• **Fluvial Cycle 4**	-	250,000 to 300,000 years b.p.	Stage 8 (?)

* Shackleton and Opdyke, 1973

Fluvial Cycle 4 deposits are displaced in the upper reservoir across the bedrock-step fault at site C. Further, there is some evidence that the gravel of Fluvial Cycle 3 overlying bedrock in trenches FT-1 and FT-10 (see Appendix A) is also displaced. Accordingly, independent of paleontological and radiocarbon dating techniques, the last fault movement in the reservoir area probably occurred more than about 100,000 years ago. This stratigraphic age assessment corroborates the timing of probable last displacement on the East Canyon fault, as documented by the USBR (1988a) in an area about 11 miles northeast of the Little Dell Dam.

10. **Radiocarbon Dating**. Two samples of carbon-rich organic material from peat-clay layers were collected and submitted to a commercial laboratory for radiocarbon-age assay (Cole and Bryant, 1993 - Appendix A). The first sample was obtained from wood and organic matter found in the gravelly basal unit of the Fluvial Cycle 4 deposits in trench FT-5. The second sample was collected from Fluvial Cycle 3 organic matter exposed in a cut-bank near the base of the fining-upward section where it contacts the coarse-grained basal unit. The results are as follows (Appendix A, Attachments A-2 and A-3):

- Trench FT-5 Sample - Greater than 39,000 years b.p. (Beta Analytic, Sample #55236)

- Cut-bank Sample - 37,200 years ± 600 years b.p. (Beta Analytic, Sample #56197)

The radiocarbon dates are most likely minimal owing to the high potential for contamination by much younger organic acids. Typical reasons for potential errors in radiocarbon dates (Woodward-Clyde Consultants, 1975), given the environment of the Little Dell samples, are:

- Only a small amount of contamination by groundwater or meteoric water is required to significantly change the indicated radiometric date (a condition that is present in the Little Dell reservoir area).

- In general, contaminated materials provide only minimum dates beyond 20,000 to 30,000 years b.p. (a condition likewise met at Little Dell).

- The accuracy of dates decrease, due to the small amounts of carbon-14 remaining in older samples, for material older than 30,000 years b.p.

- The limit of reliable radiocarbon dating is approximately 40,000 years

b.p., using standard laboratory procedures.

• Because of the possibility of undetected contamination in any sample, it's geologic setting and history should be reviewed before assuming the obtained date is valid.

Since both radiocarbon samples were long subject to groundwater contamination, the reported ages must, therefore, be regarded as minimal. The approximately 37,000-year-old date for the Fluvial Cycle 3 channel sediments is at the upper range of the normal radiocarbon-dating method and raises questions as it's reliability based on the reasons presented above. Further, Geyh, Benzler and Roeschmann (1971) state that a 100,000-year-old sample when contaminated by 1 percent of modern carbon (as is available from organic acids within groundwater) will yield a radiocarbon age of 37,000 years; hence this is consistent with the stratigraphic age assessment of 100,000 years or greater for Fluvial Cycle 3. Accordingly, the infinite date of 39,000 years plus for the Fluvial Cycle 4 gravel is consistent with a stratigraphic framework assessment of likely more than about 250,000 years (see Table 1).

11. **Paleontological Age Assessment**. During the trenching investigations various paleontological finds including large bones of elk or moose-size animals, zebrine horse, numerous extinct small animal bones and a portion of a Mastodon tusk were removed from within the channel deposits of Fluvial Cycles 3 and 4. A preliminary letter from the State of Utah tentatively assigned a late to middle Pleistocene age, between 11,000 years and 1,000,000 years b.p. for these specimens. Although yielding a wide age range, the paleontological assessment independently confirms the Quaternary age of the Little Dell reservoir channel deposits (see Appendix A, Attachment A-1).

12. **Conclusions**. Stratigraphically, four (4) cycles of fluvial channel deposition are identified within the reservoir borrow area overlying bedrock of the Cretaceous age Kelvin and Frontier Formations. Bedrock steps within the Frontier Formation coincide

with sheared and faulted bedding planes exhibiting a hanging-wall-up (reverse) sense of movement. The fault at site C has displaced and/or distorted Fluvial Cycle 4 deposits and the faults at all three identified sites, A, B and C, appear to have displaced a portion of the lower-most (oldest) basal gravel of Fluvial Cycle 3. There is no evidence, however, that any of the displacement has extended upward through the entire thickness of the gravel or into the fining-upward portion (overbank deposits) of Fluvial Cycle 3.

Radiocarbon dates for Fluvial Cycles 4 and 3 deposits are infinite and approximately 37,000 years old, respectively. However, there is a high probability that the dated samples have been substantially contaminated by younger groundwater-derived organic acids. The radiocarbon dates are, therefore, regarded as minimal ages.

Stratigraphic-age assessments, based on identification of regionally-extensive channel systems dated by association with major glacial-interglacial alternations (marine oxygen-isotope stage chronology) indicate that the last movement of the faults is in the basal gravel of the estimated 130,000 to 200,000-year-old Fluvial Cycle 3. The upper gravel and the associated overbank deposits are not displaced.

Stratigraphically, therefore, the last fault movement occurred prior to 60,000 to 70,000 years b.p. (Fluvial Cycle 2) and most likely well before 100,000 years b.p. In accordance with Corps of Engineers active (capable) fault criteria of displacement within the last 35,000 years, all three reservoir borrow area faults are judged not capable and, therefore, do not impact the design or construction of Little Dell Dam.

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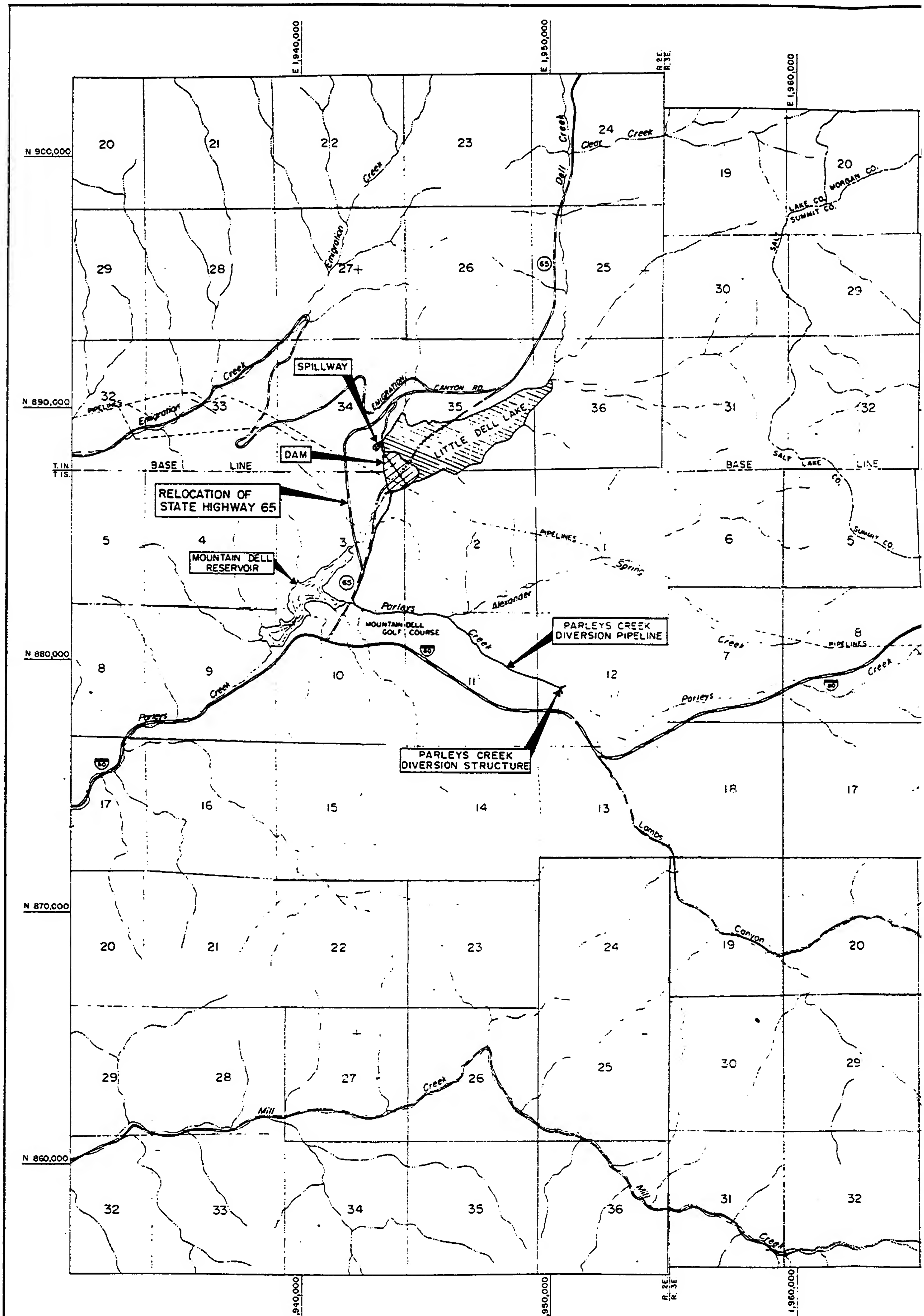
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N 890,000
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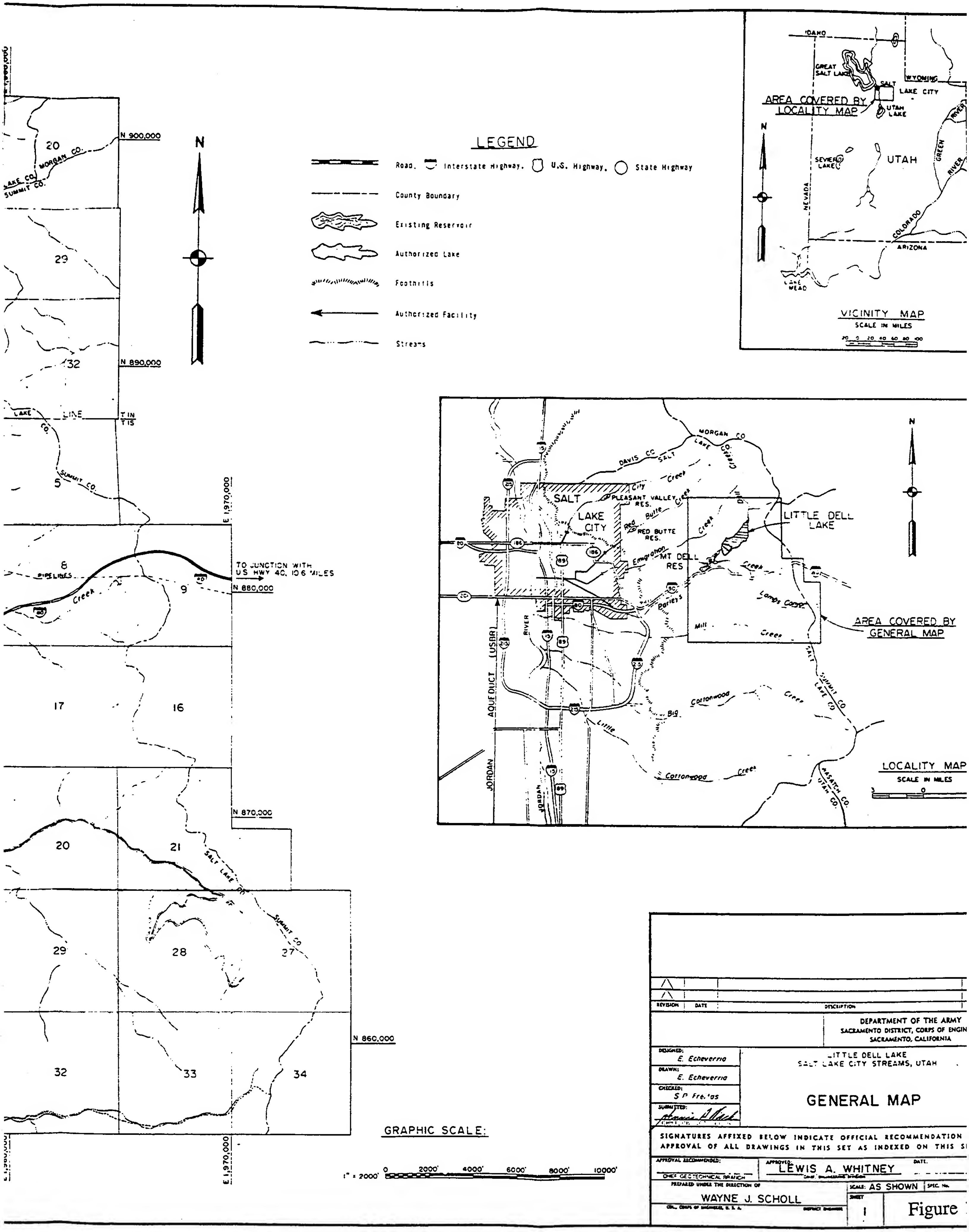
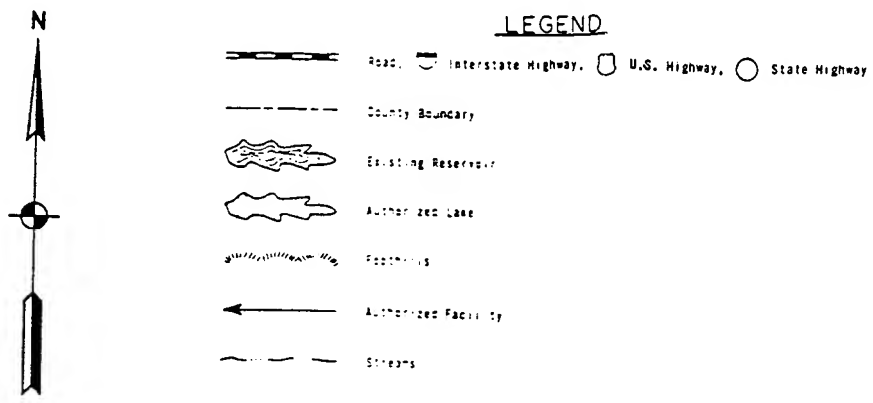
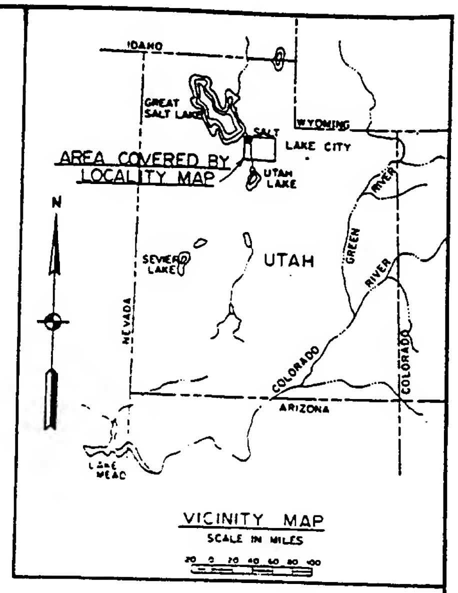
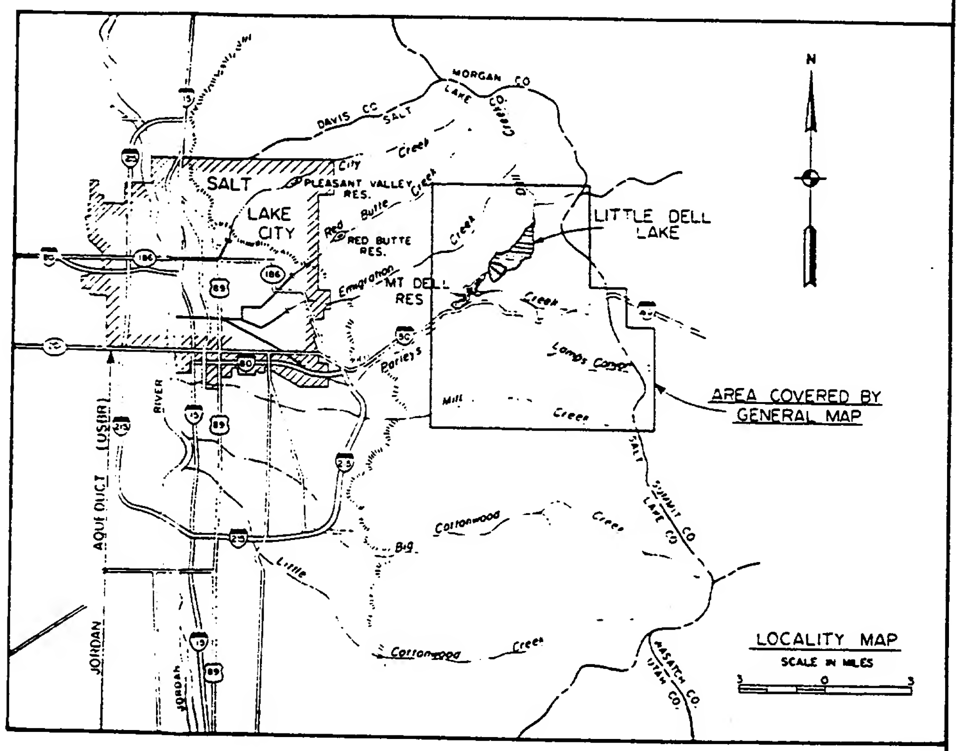
N 860,000
E 1,940,000
E 1,950,000
E 1,960,000
R.2E.
R.3E.
T.1N.
T.1S.
BASE LINE
SPILLWAY
DAM
RELOCATION OF STATE HIGHWAY 65
MOUNTAIN DELL RESERVOIR
MOUNTAIN DELL GOLF COURSE
LITTLE DELL LAKE
PARLEYS CREEK DIVERSION PIPELINE
PARLEYS CREEK DIVERSION STRUCTURE
EMIGRATION CANYON RD.
PIPELINES
Emigration Creek
Dell Creek
Clear Creek
Parleys Creek
Alexander
Spring
Lambs Canyon
Mill Creek
SALT LAKE CO.
MORGAN CO.
SUMMIT CO.

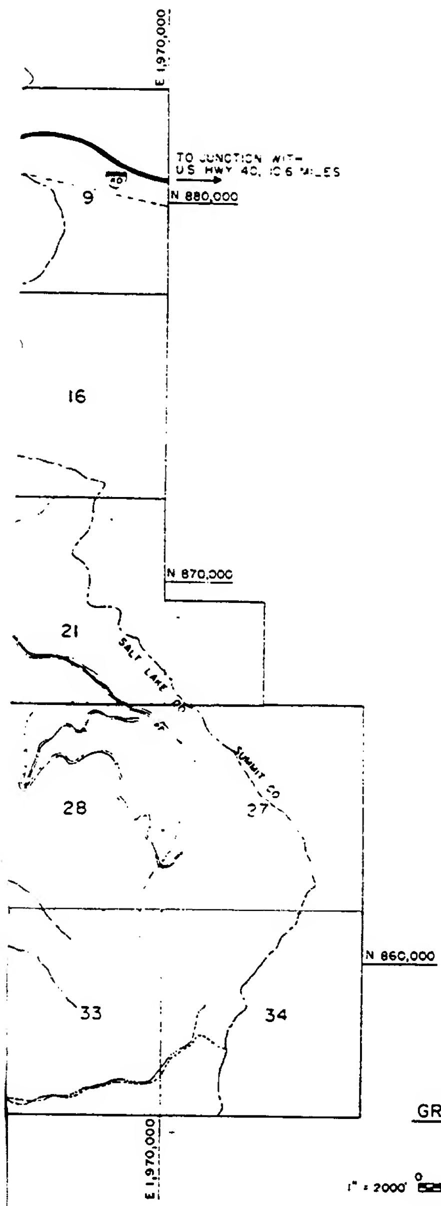
GENERAL MAP


LEGEND
Road, Interstate Highway, U.S. Highway, State Highway
County Boundary
Existing Reservoir
Authorized Lake
Foothills
Authorized Facility
Streams
N 900,000
N 890,000
N 880,000
N 870,000
N 860,000
E 1,970,000
MORGAN CO.
SALT LAKE CO.
SUMMIT CO.
TO JUNCTION WITH US HWY 40, 10.6 MILES
PIPELINES
Creek
T1N
T1S
GRAPHIC SCALE:
1" = 2000'
0 2000' 4000' 6000' 8000' 10000'
IDAHO
GREAT SALT LAKE
WYOMING
SALT LAKE CITY
AREA COVERED BY LOCALITY MAP
UTAH LAKE
SEVIER LAKE
UTAH
NEVADA
GREEN RIVER
COLORADO
ARIZONA
LAKE MEAD
VICINITY MAP
SCALE IN MILES
MORGAN CO.
DAVIS CO.
SALT LAKE CO.
City Creek
SALT LAKE CITY
PLEASANT VALLEY RES.
Red Butte Creek
RED BUTTE RES.
Emigration Creek
MT DELL RES
LITTLE DELL LAKE
Parleys
Lambs Canyon
Mill Creek
AREA COVERED BY GENERAL MAP
Big Cottonwood Creek
Little Cottonwood Creek
SUMMIT CO.
WASATCH CO.
UTAH CO.
JORDAN AQUEDUCT (USBR)
JORDAN RIVER
LOCALITY MAP
SCALE IN MILES
REVISION
DATE
DESCRIPTION
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGIN
SACRAMENTO, CALIFORNIA
DESIGNED: E. Echeverria
DRAWN: E. Echeverria
CHECKED: S P Freitas
SUBMITTED:
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
GENERAL MAP
SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION
APPROVAL OF ALL DRAWINGS IN THIS SET AS INDEXED ON THIS SI
APPROVAL RECOMMENDED:
CHIEF GEOTECHNICAL BRANCH
APPROVED: LEWIS A. WHITNEY
PREPARED UNDER THE DIRECTION OF
WAYNE J. SCHOLL
DISTRICT ENGINEER
SCALE: AS SHOWN
SHEET 1
Figure









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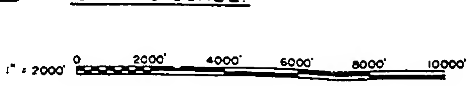

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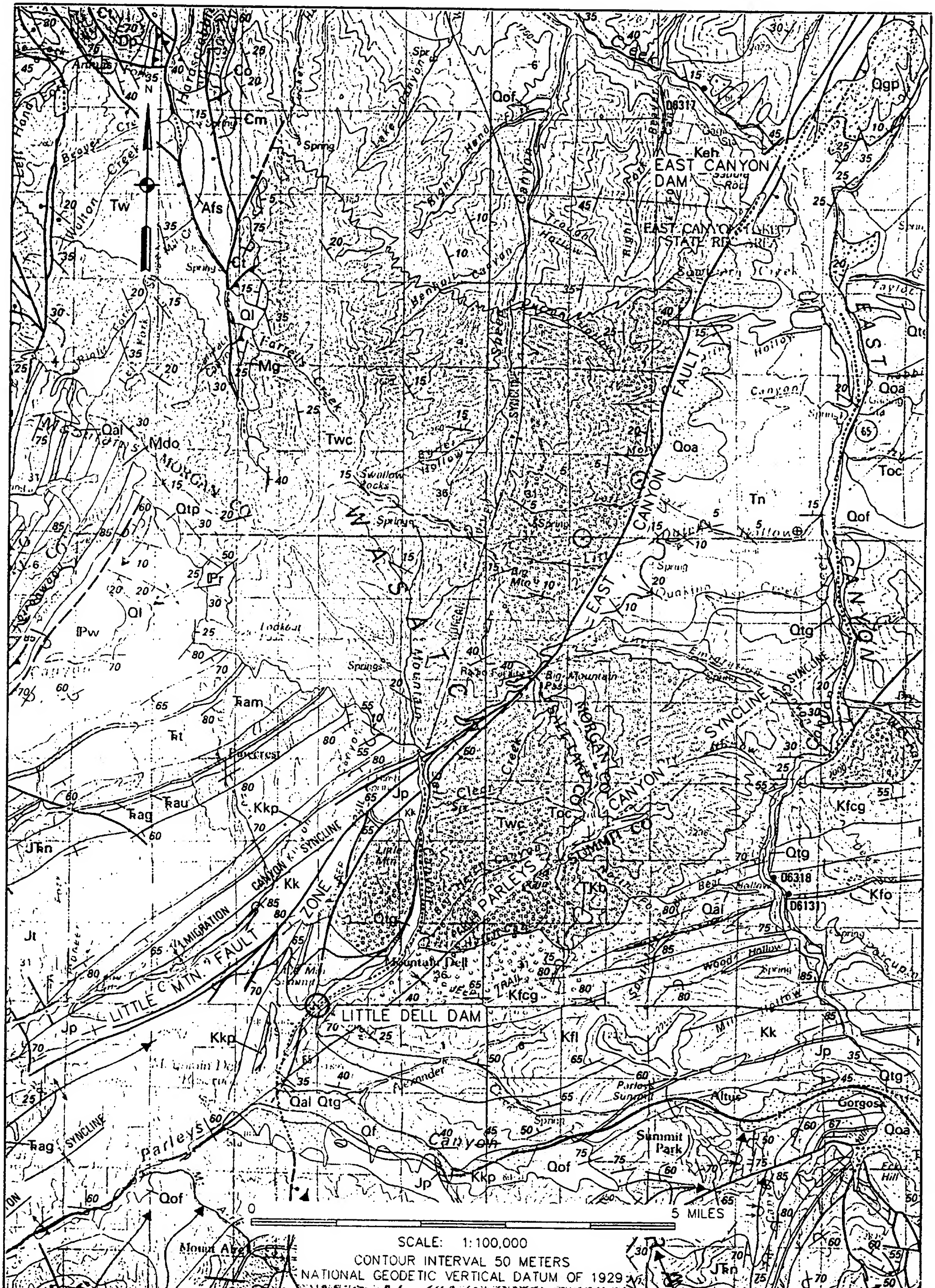
	DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
DESIGNED: E. Echeverria DRAWN: E. Echeverria CHECKED: S P Freitas SUBMITTED:	LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH GENERAL MAP

SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDEXED ON THIS SHEET

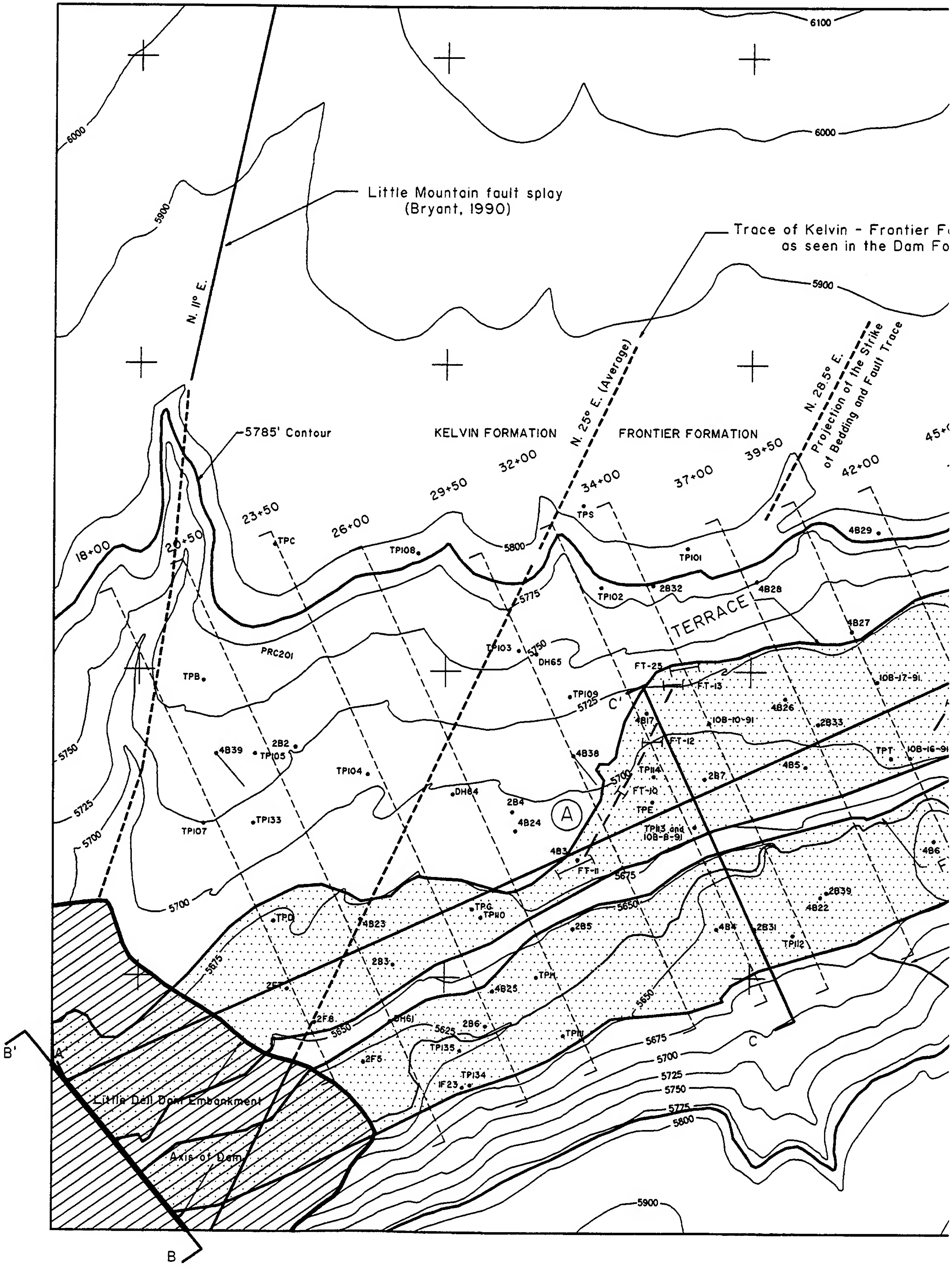
APPROVAL RECOMMENDED: CHIEF GEOTECHNICAL BRANCH	APPROVED: LEWIS A. WHITNEY	DATE:
PREPARED UNDER THE DIRECTION OF WAYNE J. SCHOLL	SCALE: AS SHOWN	SPEC. No. -
	SHEET 1	Figure 1



SOURCE: Geologic Map of the Salt Lake City 30'x60' Quadrangle, North-Central Utah, and Unita County, Wyoming, USGS Miscellaneous Investigation Series Map I-1944, Bruce Bryant, 1990

GEOLOGIC MAP

Figure 2


Little Mountain fault splay
(Bryant, 1990)
Trace of Kelvin - Frontier F
as seen in the Dam Fo
N. 11° E.
N. 25° E. (Average)
N. 28.5° E.
Projection of the Strike
of Bedding and Fault Trace
5785' Contour
KELVIN FORMATION
FRONTIER FORMATION
TERRACE
Little Dell Dam Embankment
Axis of Dam
18+00
20+50
23+50
26+00
29+50
32+00
34+00
37+00
39+50
42+00
6100
6000
5900
5800
5775
5750
5725
5700
5675
5650
5625
TPC
TP108
TPS
TP101
TP102
2B32
4B28
4B29
4B27
PRC201
TP103
DH65
FT-25
FT-13
10B-17-91
TPB
TP109
C'
4B17
10B-10-91
4B26
2B33
4B39
2B2
TP105
4B38
FT-12
TPT
10B-16-91
TP104
TP114
FT-10
2B7
4B5
DH64
2B4
4B24
TPE
TP113 and 10B-8-91
TP107
TP133
4B3
FT-11
4B6
TPD
TPG
TP110
4B23
2B5
4B4
2B31
2B39
4B22
TP112
2B3
2F7
TPH
4B25
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DH61
2B6
TP111
TP135
2F5
TP134
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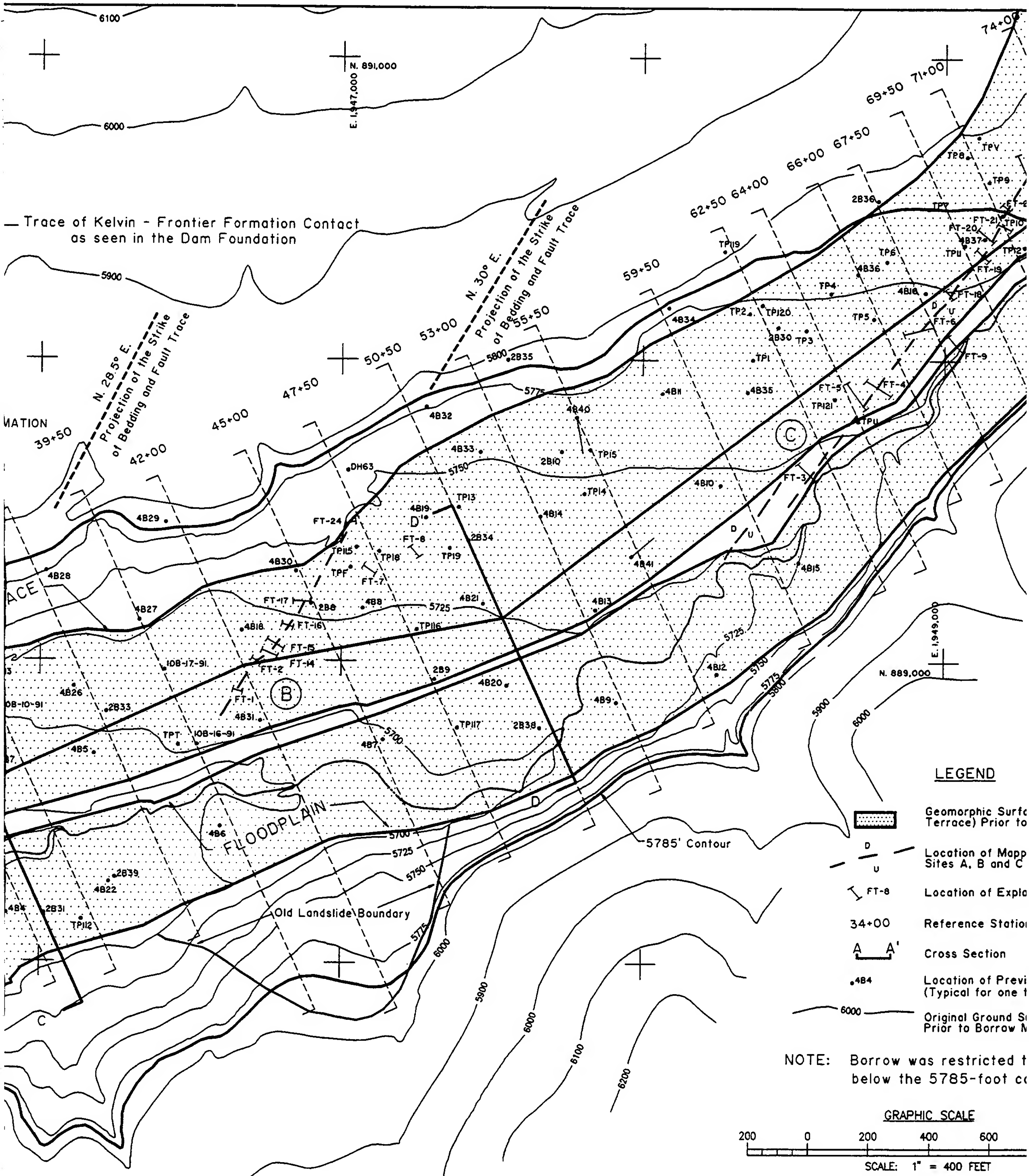
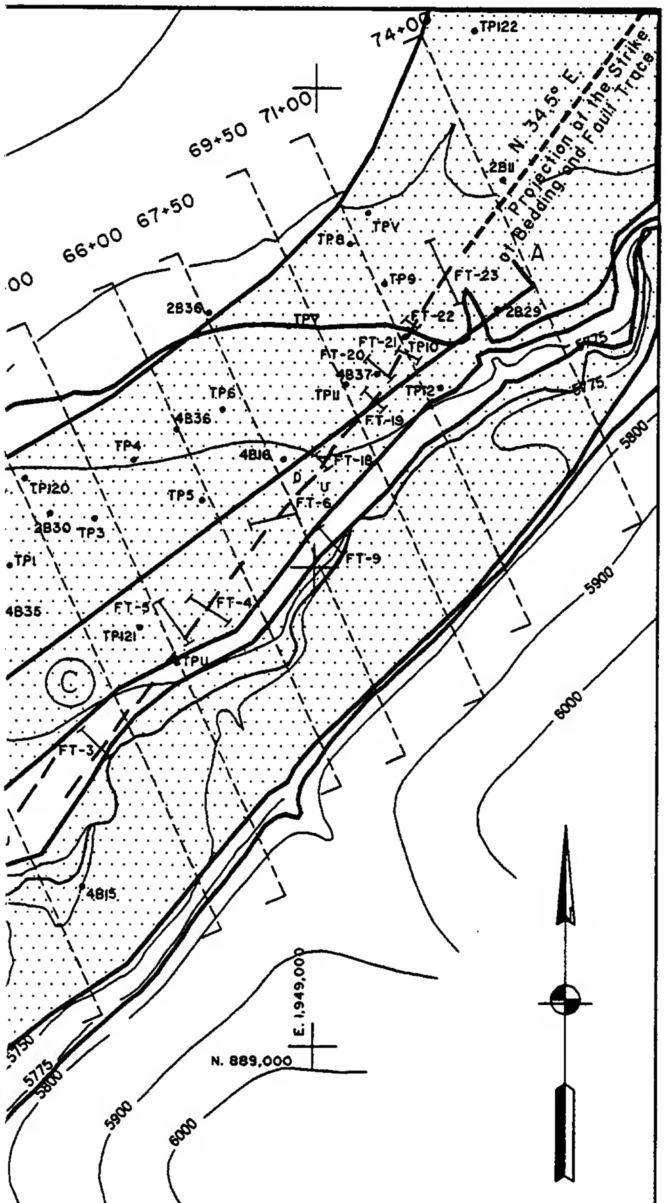
B'
A'
B
C
A



BORROW AREA LOCATION MAP - LITTLE DELL DA



LEGEND

Geomorphic Surface (Floodplain or Terrace) Prior to Construction

D U — Location of Mapped Fault Trace; Sites A, B and C Circled

FT-8 — Location of Exploratory Trench

34+00 — Reference Stationing

A A' — Cross Section

•4B4 — Location of Previous Explorations (Typical for one type only)

6000 — Original Ground Surface Contours Prior to Borrow Material Removal

NOTE: Borrow was restricted to select areas below the 5785-foot contour

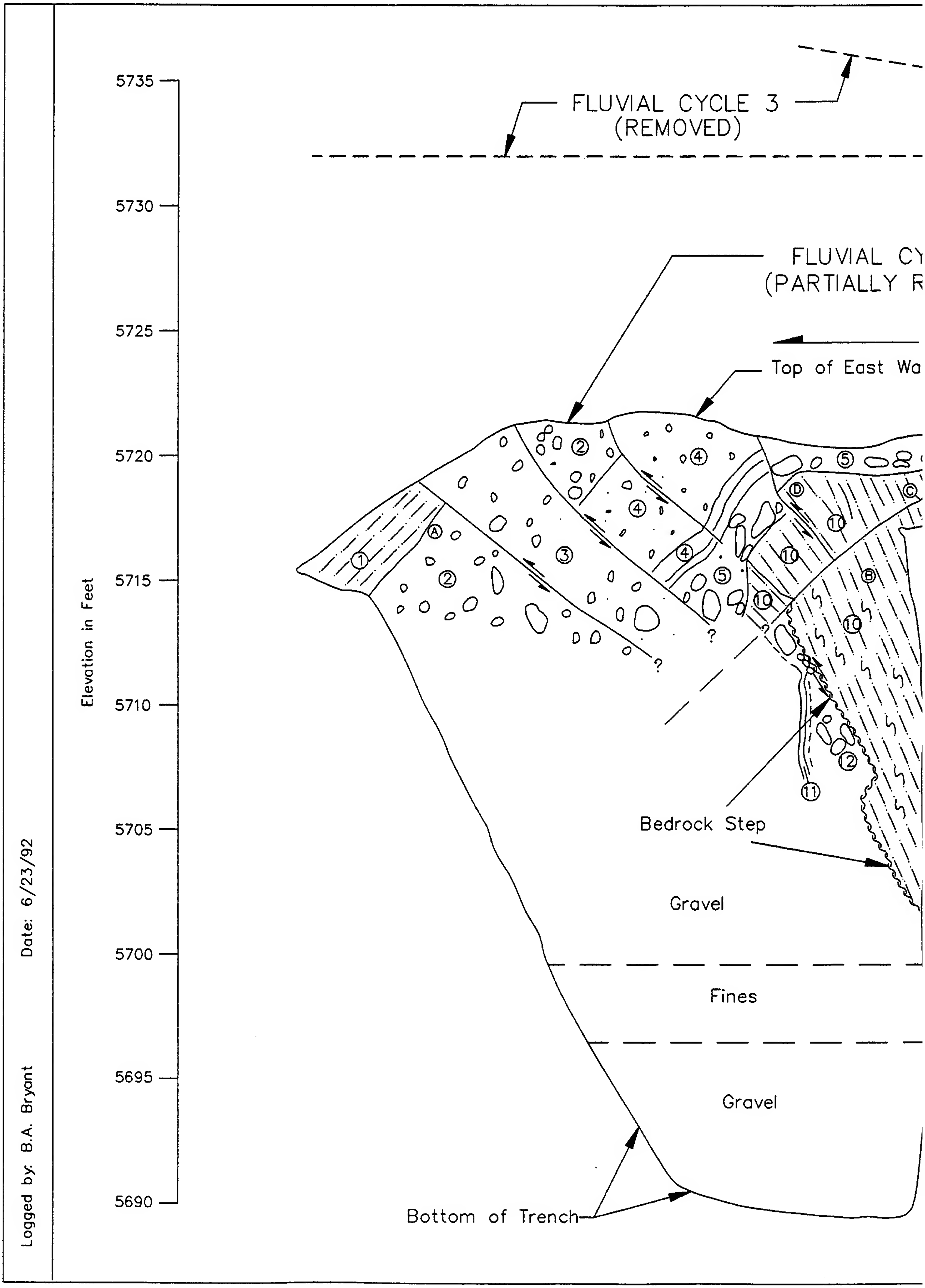
GRAPHIC SCALE

0 0 200 400 600 800 1000 FEET

SCALE: 1" = 400 FEET

TION MAP - LITTLE DELL DAM, UTAH

FIGURE 3


Logged by: B.A. Bryant
Date: 6/23/92
Elevation in Feet
5735
5730
5725
5720
5715
5710
5705
5700
5695
5690
FLUVIAL CYCLE 3
(REMOVED)
FLUVIAL CY
(PARTIALLY R
Top of East Wa
Bedrock Step
Gravel
Fines
Gravel
Bottom of Trench
1
2
3
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12
A
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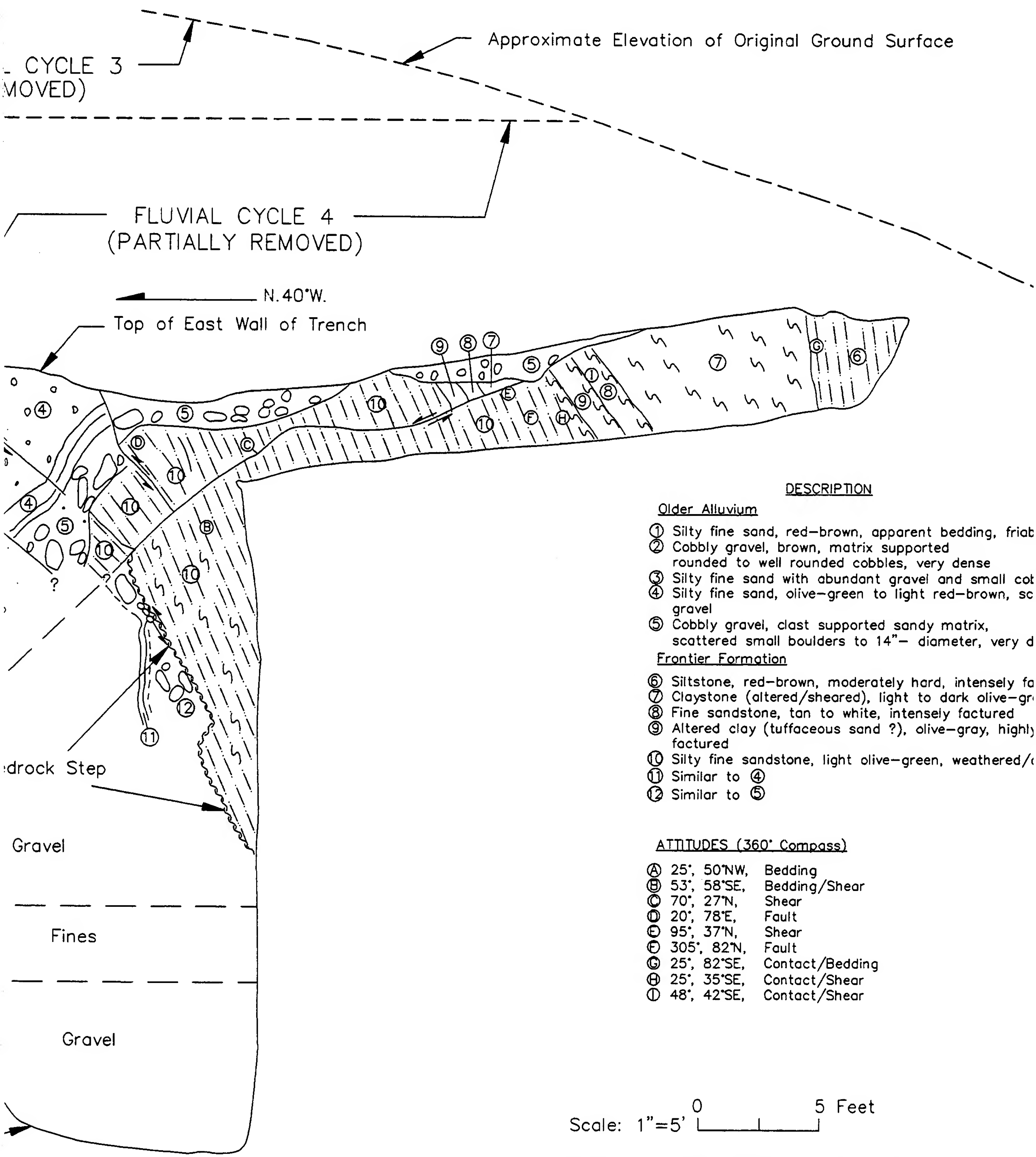
?



DESCRIPTION

Older Alluvium

① Silty fine sand, red–brown, apparent bedding, friab
② Cobbly gravel, brown, matrix supported rounded to well rounded cobbles, very dense
③ Silty fine sand with abundant gravel and small cob
④ Silty fine sand, olive–green to light red–brown, sc gravel
⑤ Cobbly gravel, clast supported sandy matrix, scattered small boulders to 14"– diameter, very d

Frontier Formation

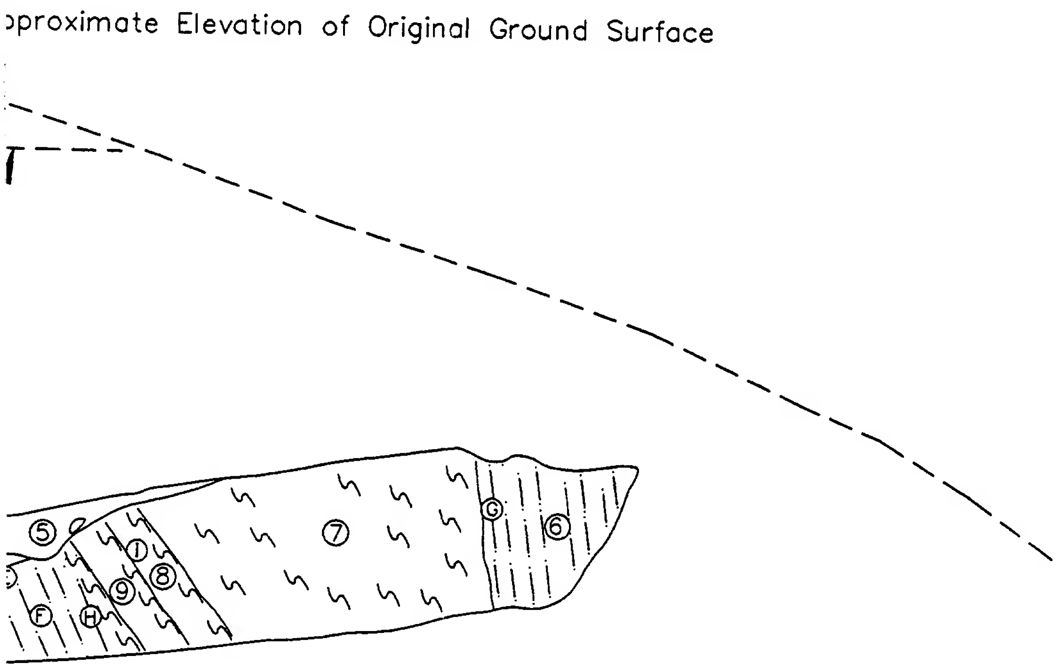
⑥ Siltstone, red–brown, moderately hard, intensely fa
⑦ Claystone (altered/sheared), light to dark olive–gr
⑧ Fine sandstone, tan to white, intensely factured
⑨ Altered clay (tuffaceous sand ?), olive–gray, highly factured
⑩ Silty fine sandstone, light olive–green, weathered/
⑪ Similar to ④
⑫ Similar to ⑤

ATTITUDES (360° Compass)

Ⓐ 25°,	50°NW,	Bedding
Ⓑ 53°,	58°SE,	Bedding/Shear
Ⓒ 70°,	27°N,	Shear
Ⓓ 20°,	78°E,	Fault
Ⓔ 95°,	37°N,	Shear
Ⓕ 305°,	82°N,	Fault
Ⓖ 25°,	82°SE,	Contact/Bedding
Ⓗ 25°,	35°SE,	Contact/Shear
Ⓘ 48°,	42°SE,	Contact/Shear

Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 3



DESCRIPTION

Older Alluvium

① Silty fine sand, red–brown, apparent bedding, friable
② Cobbly gravel, brown, matrix supported rounded to well rounded cobbles, very dense
③ Silty fine sand with abundant gravel and small cobbles
④ Silty fine sand, olive–green to light red–brown, scattered gravel
⑤ Cobbly gravel, clast supported sandy matrix, scattered small boulders to 14"– diameter, very dense

Frontier Formation

⑥ Siltstone, red–brown, moderately hard, intensely factured
⑦ Claystone (altered/sheared), light to dark olive–green
⑧ Fine sandstone, tan to white, intensely factured
⑨ Altered clay (tuffaceous sand ?), olive–gray, highly to intensely factured
⑩ Silty fine sandstone, light olive–green, weathered/altered texture
⑪ Similar to ④
⑫ Similar to ⑤

ATTITUDES (360° Compass)

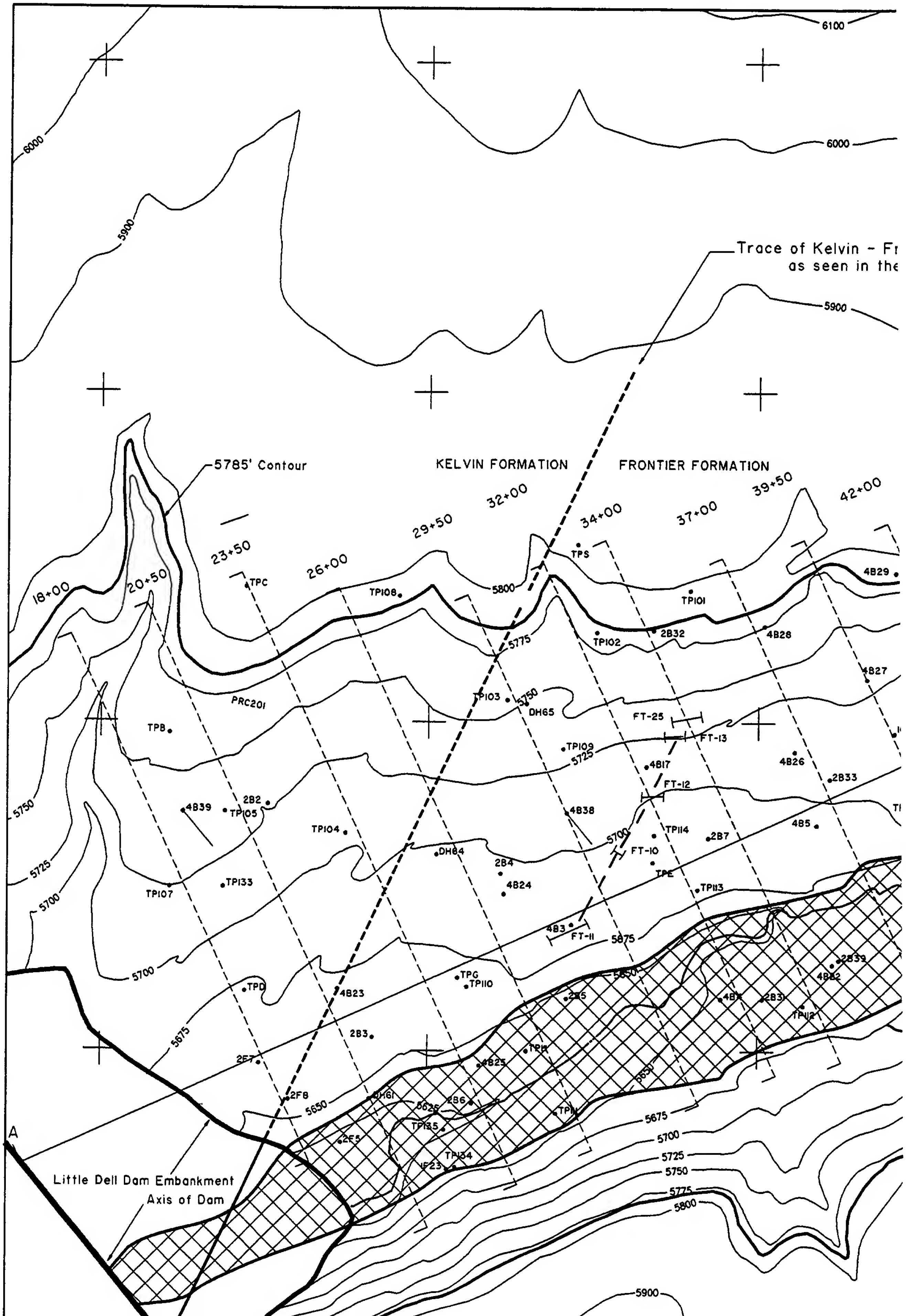
Ⓐ 25°, 50°NW, Bedding
Ⓑ 53°, 58°SE, Bedding/Shear
Ⓒ 70°, 27°N, Shear
Ⓓ 20°, 78°E, Fault
Ⓔ 95°, 37°N, Shear
Ⓕ 305°, 82°N, Fault
Ⓖ 25°, 82°SE, Contact/Bedding
Ⓗ 25°, 35°SE, Contact/Shear
Ⓘ 48°, 42°SE, Contact/Shear

Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 3

FT – 3

Figure 4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TP102
TP103
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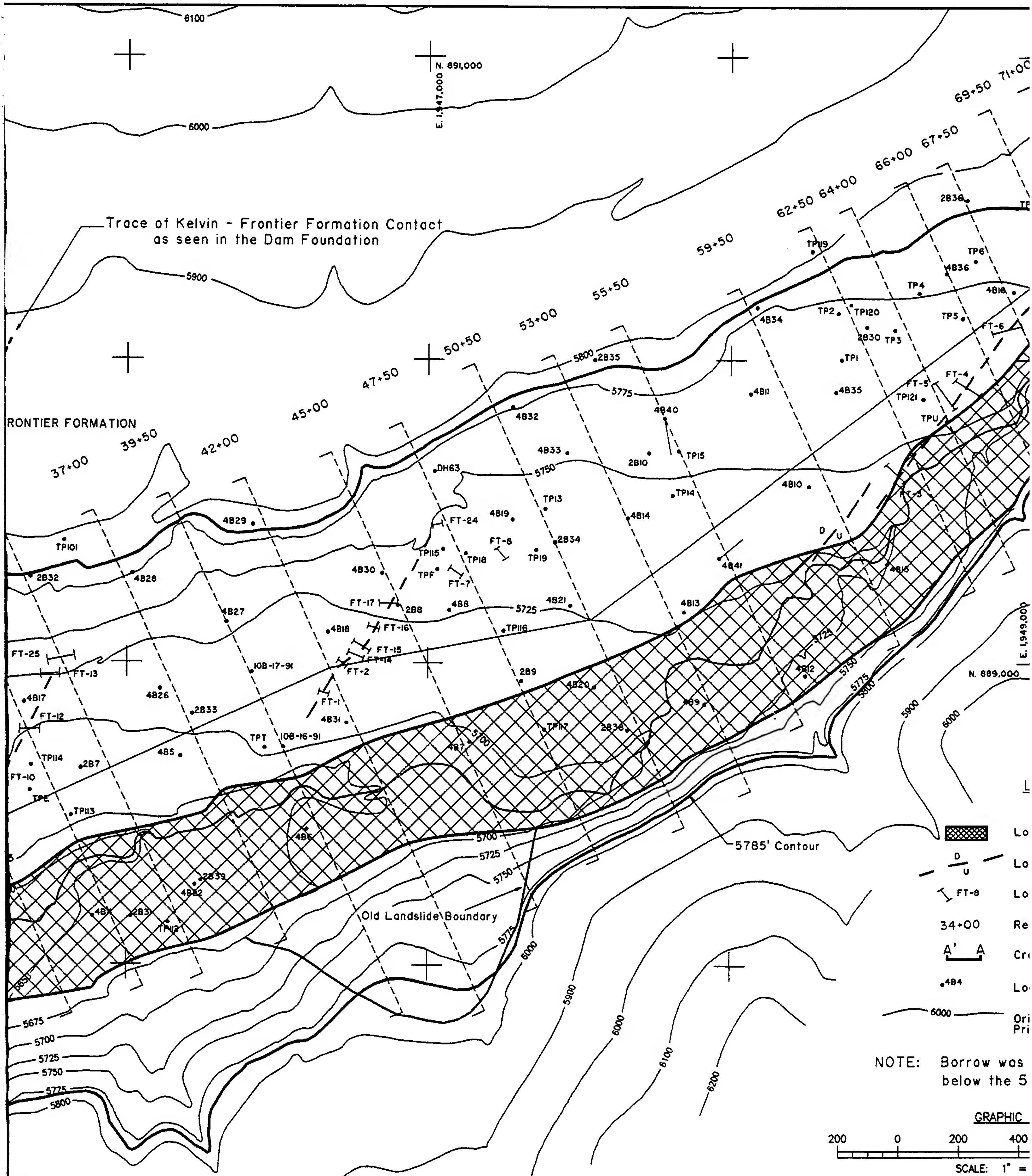
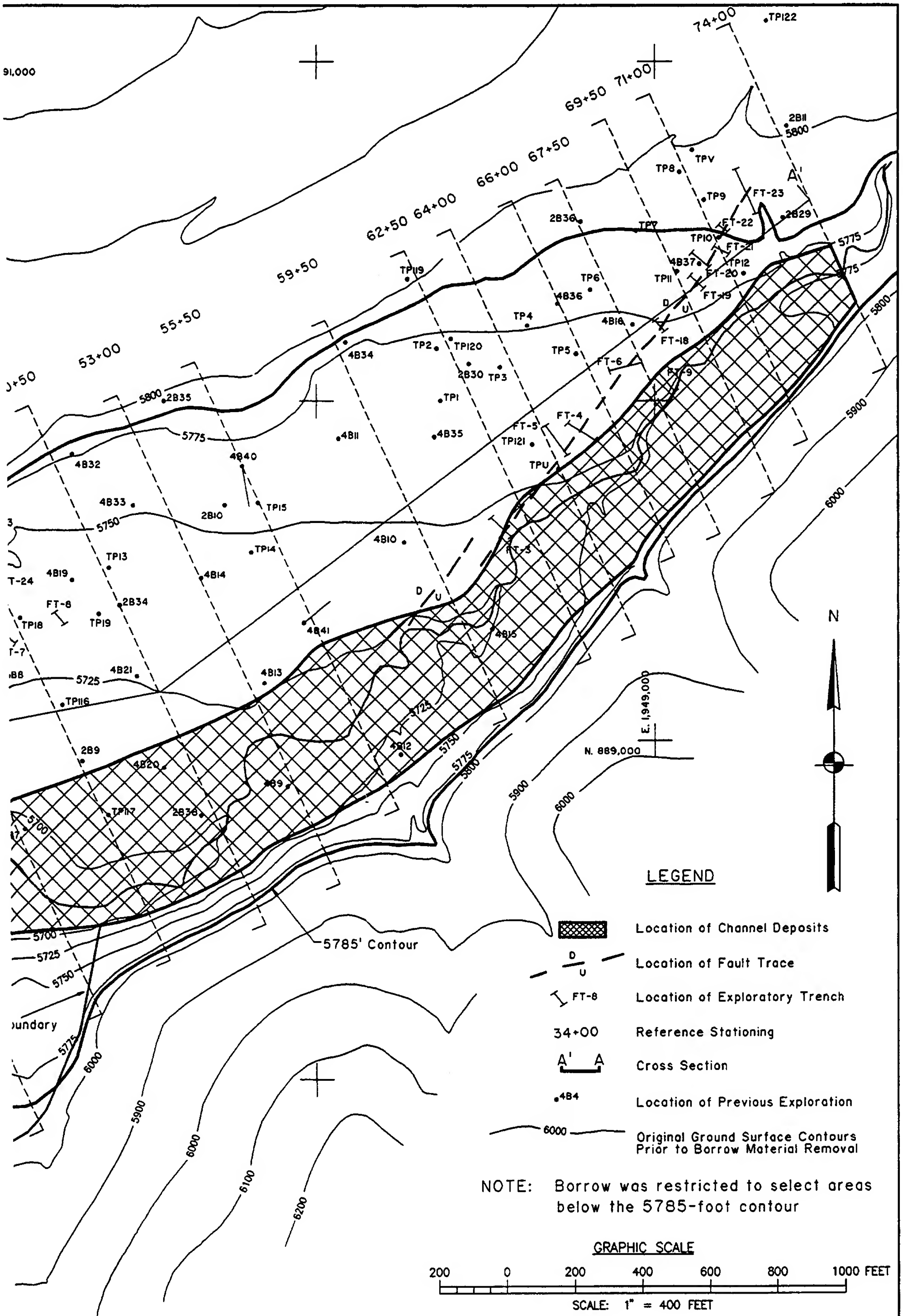
Little Dell Dam Embankment
Axis of Dam

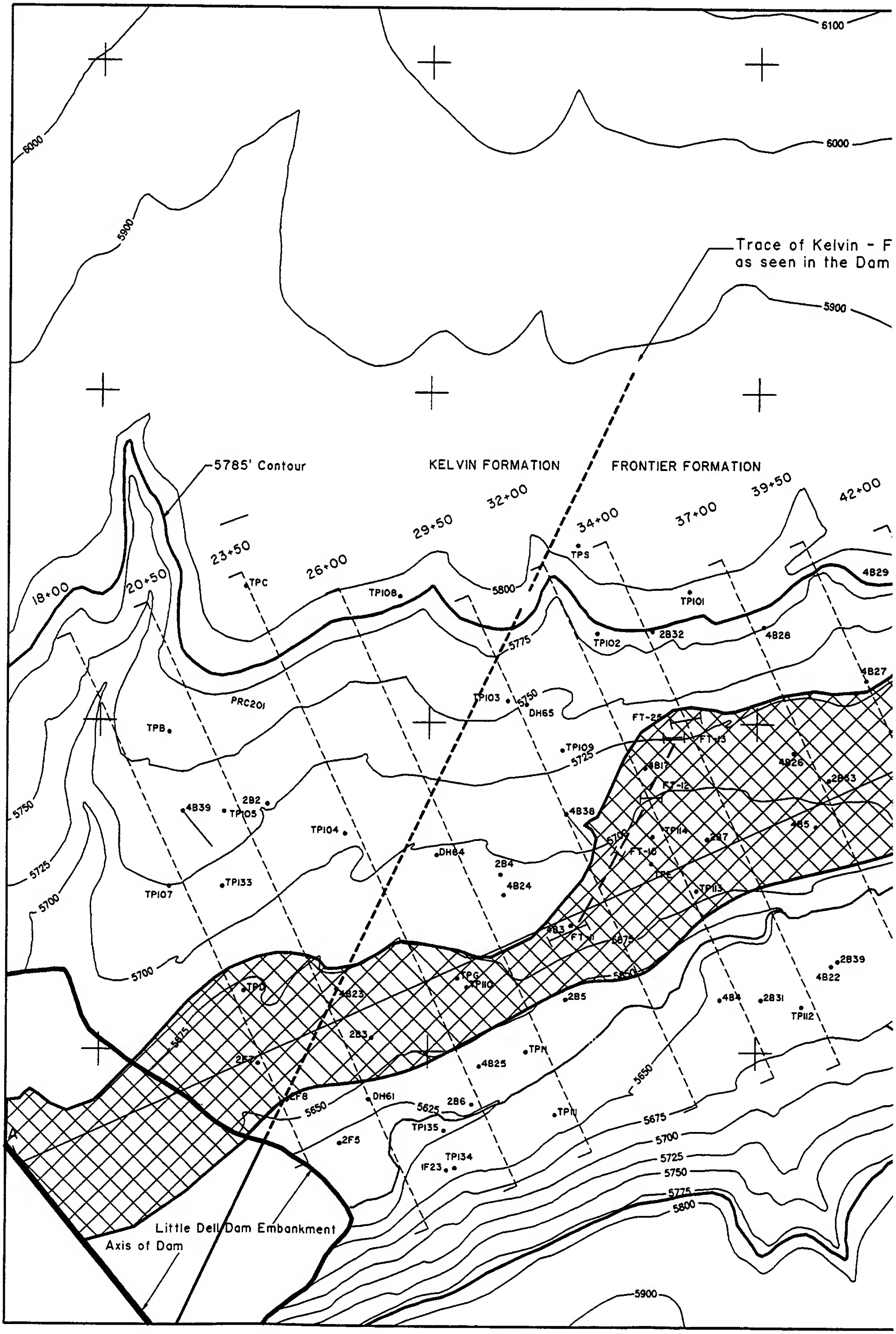


AREAL EXTENT OF FLUVIAL CYCLE - I C



AREAL EXTENT OF FLUVIAL CYCLE - I CHANNEL DEPOSITS

FIGURE 5



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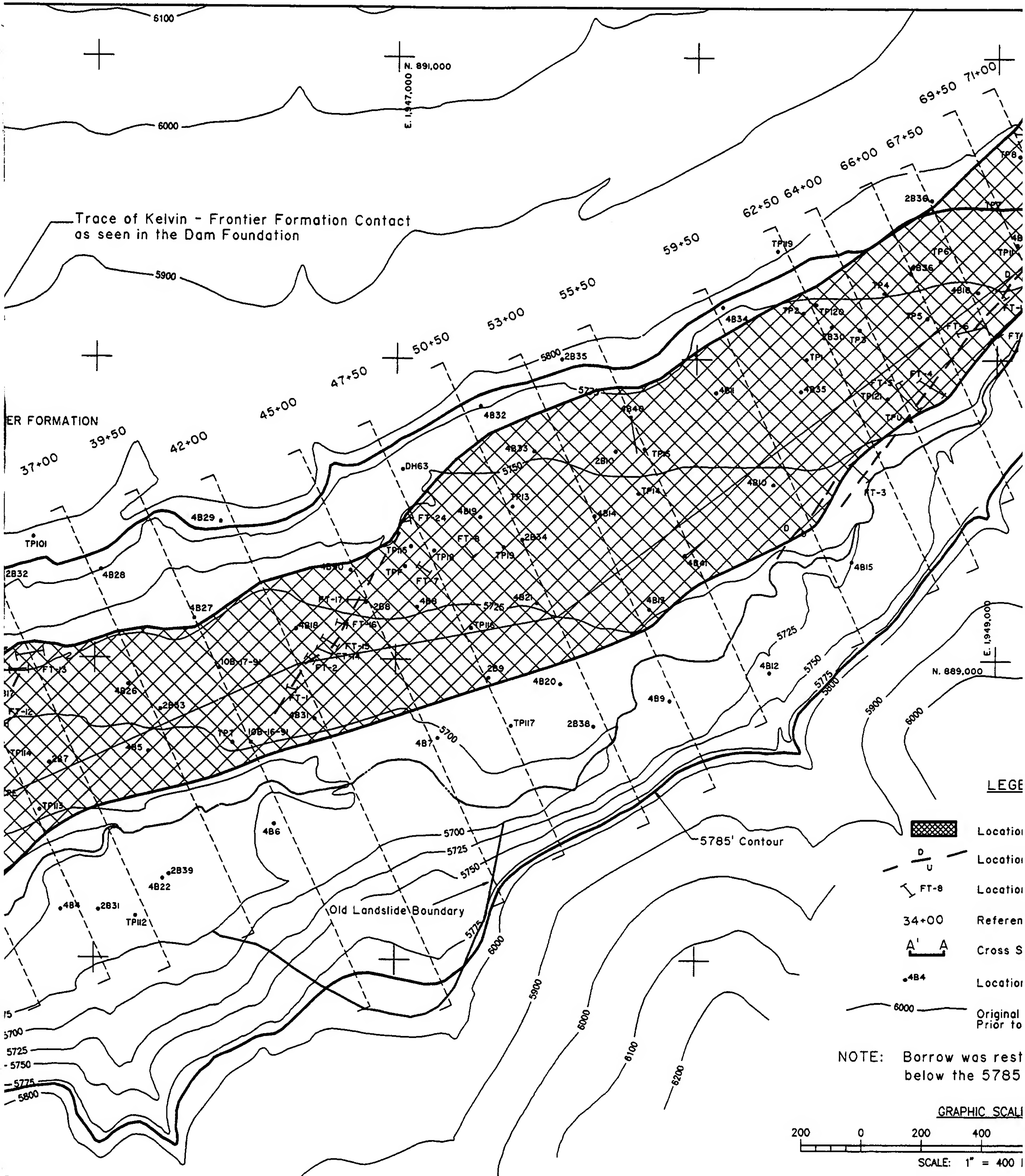
Little Dell Dam Embankment
Axis of Dam



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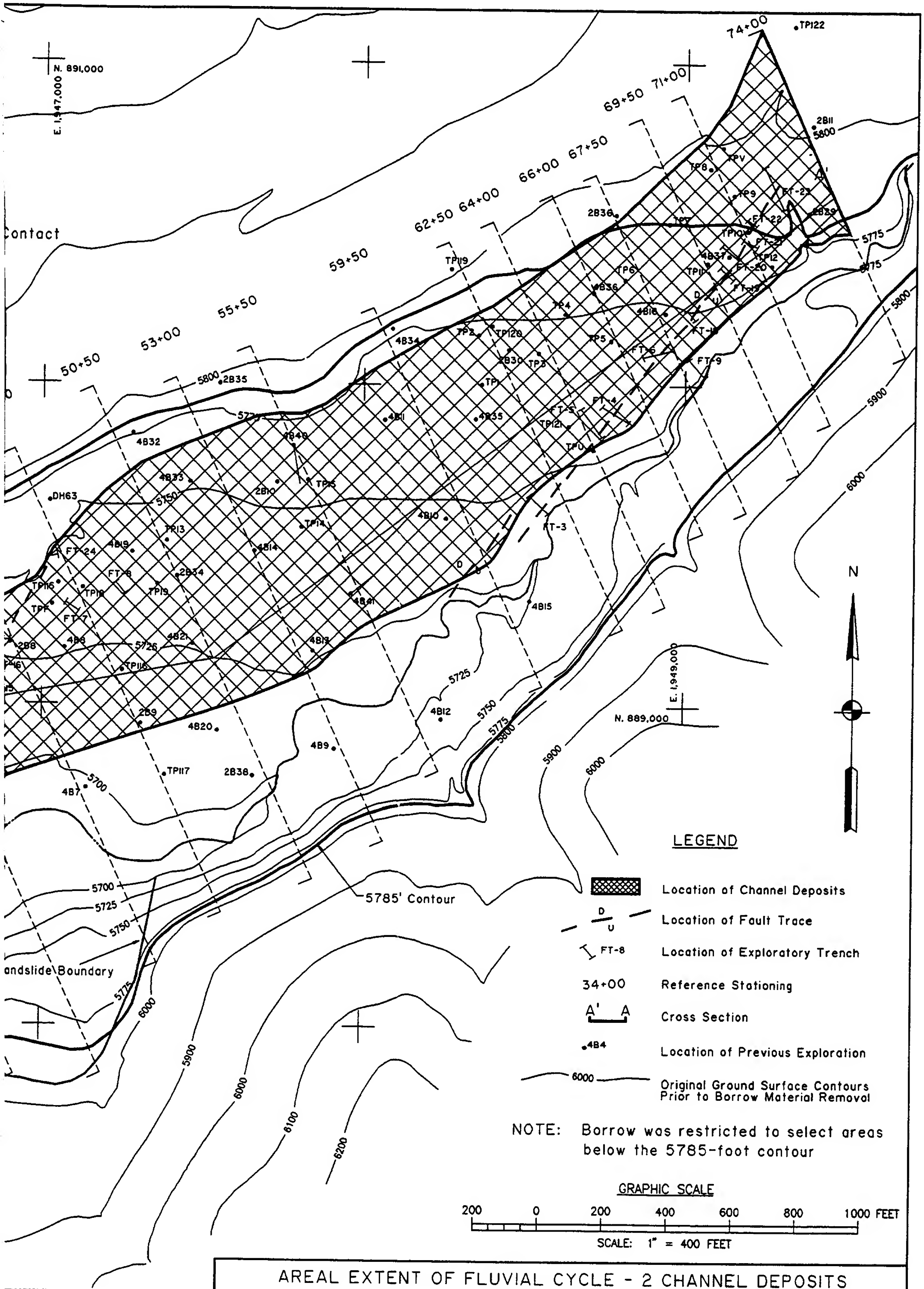
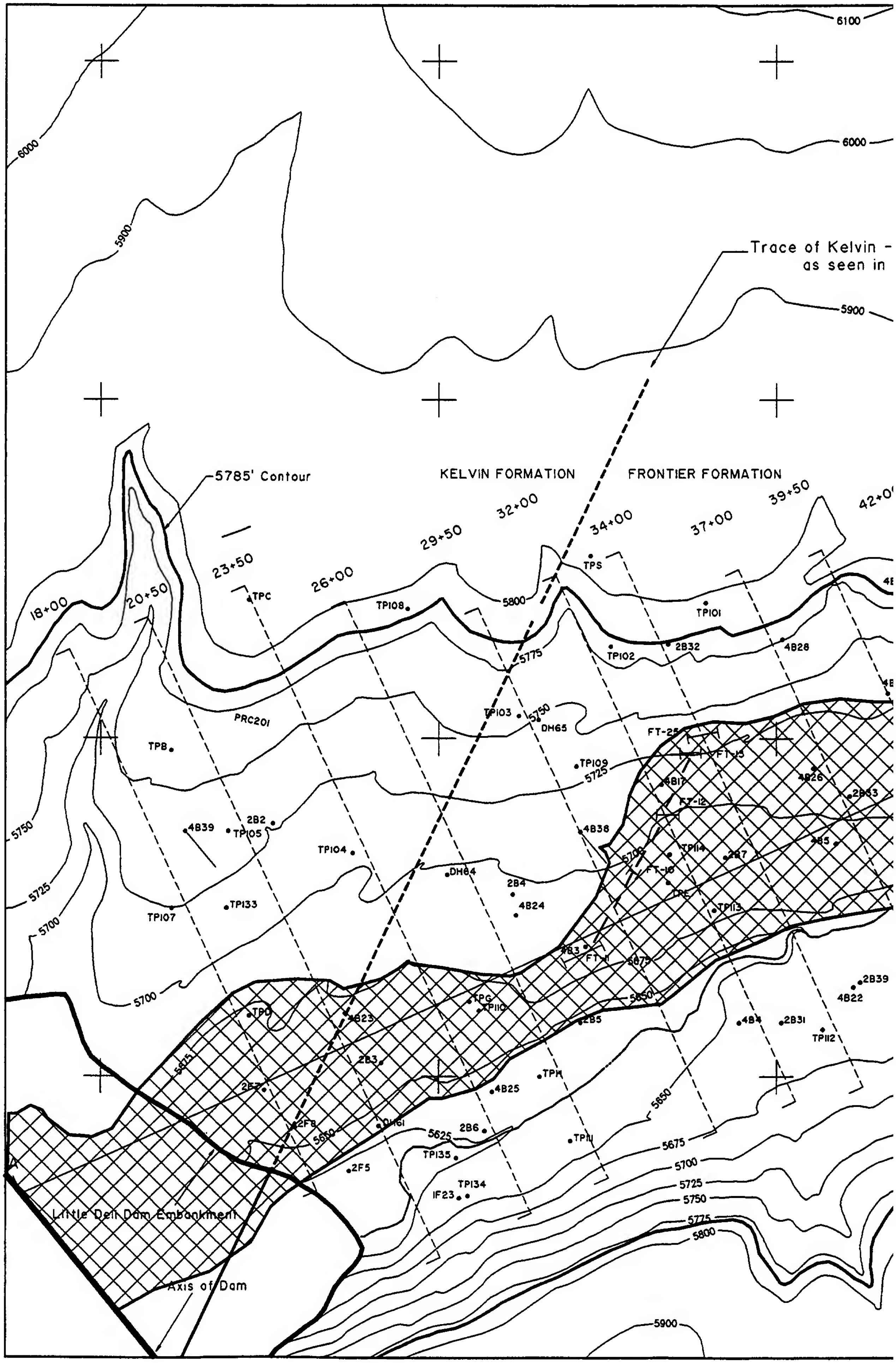


AREAL EXTENT OF FLUVIAL CYCLE - 2 CHANNEL DEPOSITS

FIGURE 6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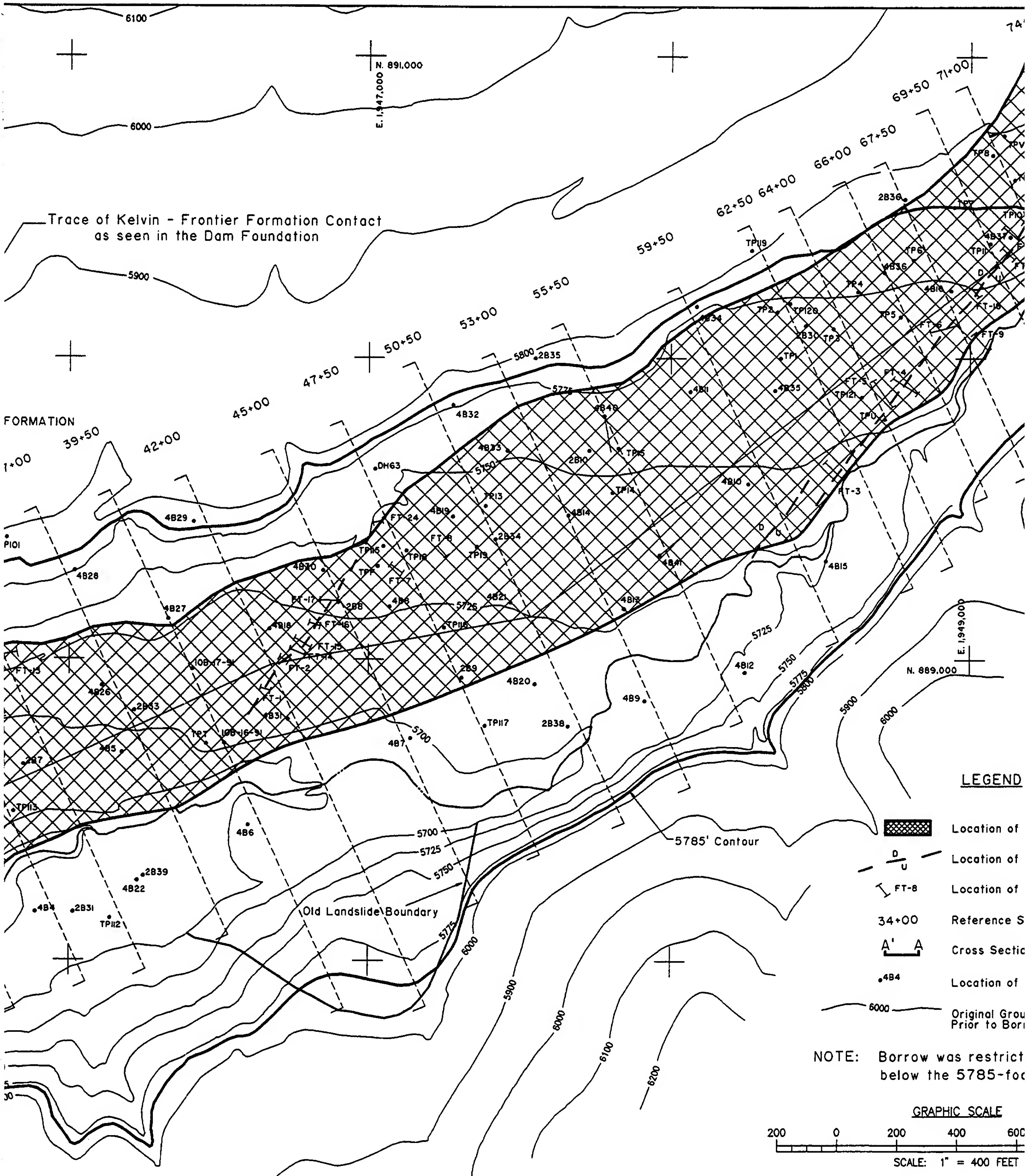
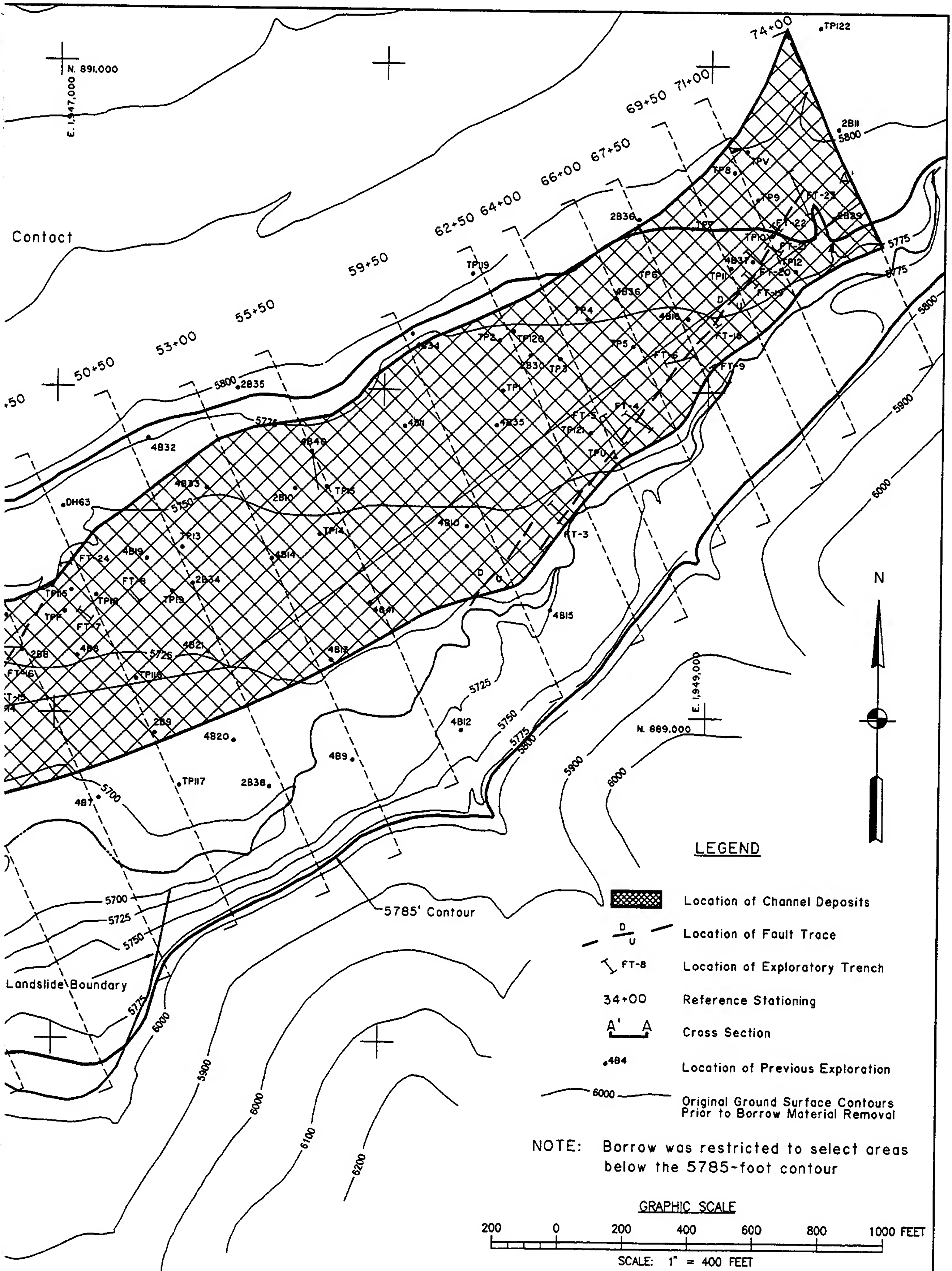
Little Dell Dam Embankment
Axis of Dam

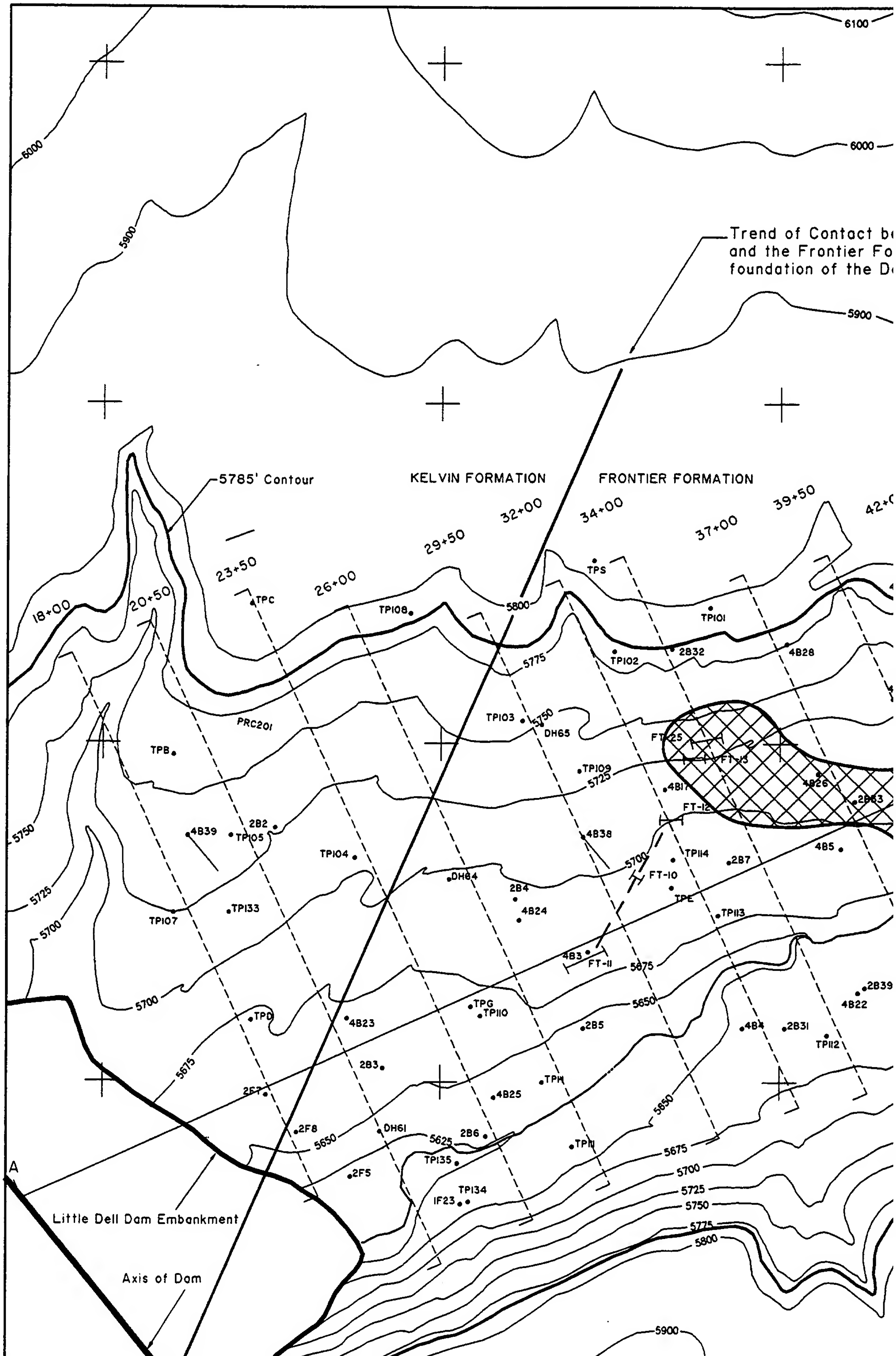


AREAL EXTENT OF FLUVIAL CYCLE - 3 CHANNE



AREAL EXTENT OF FLUVIAL CYCLE - 3 CHANNEL DEPOSITS

FIGURE 7



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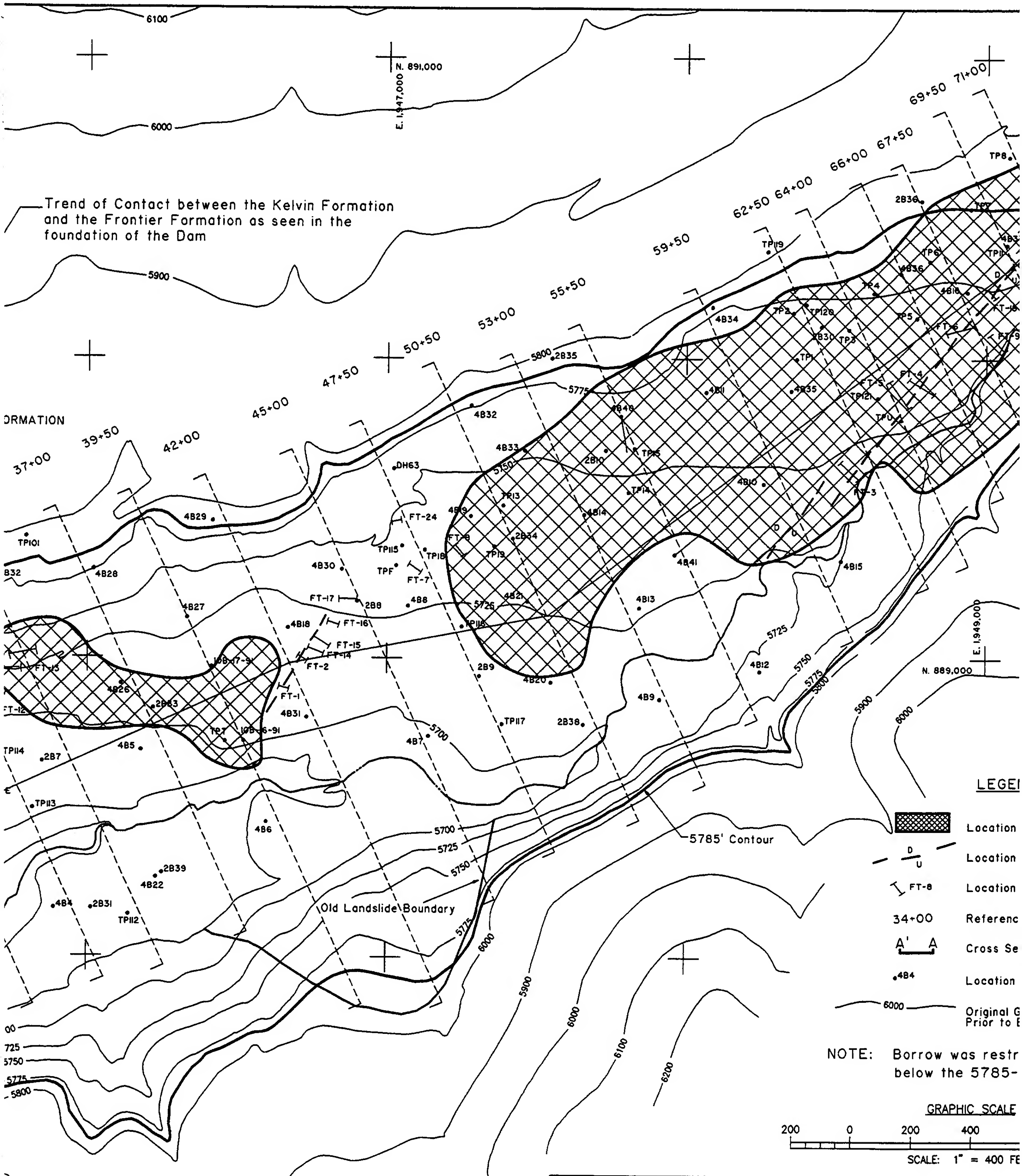

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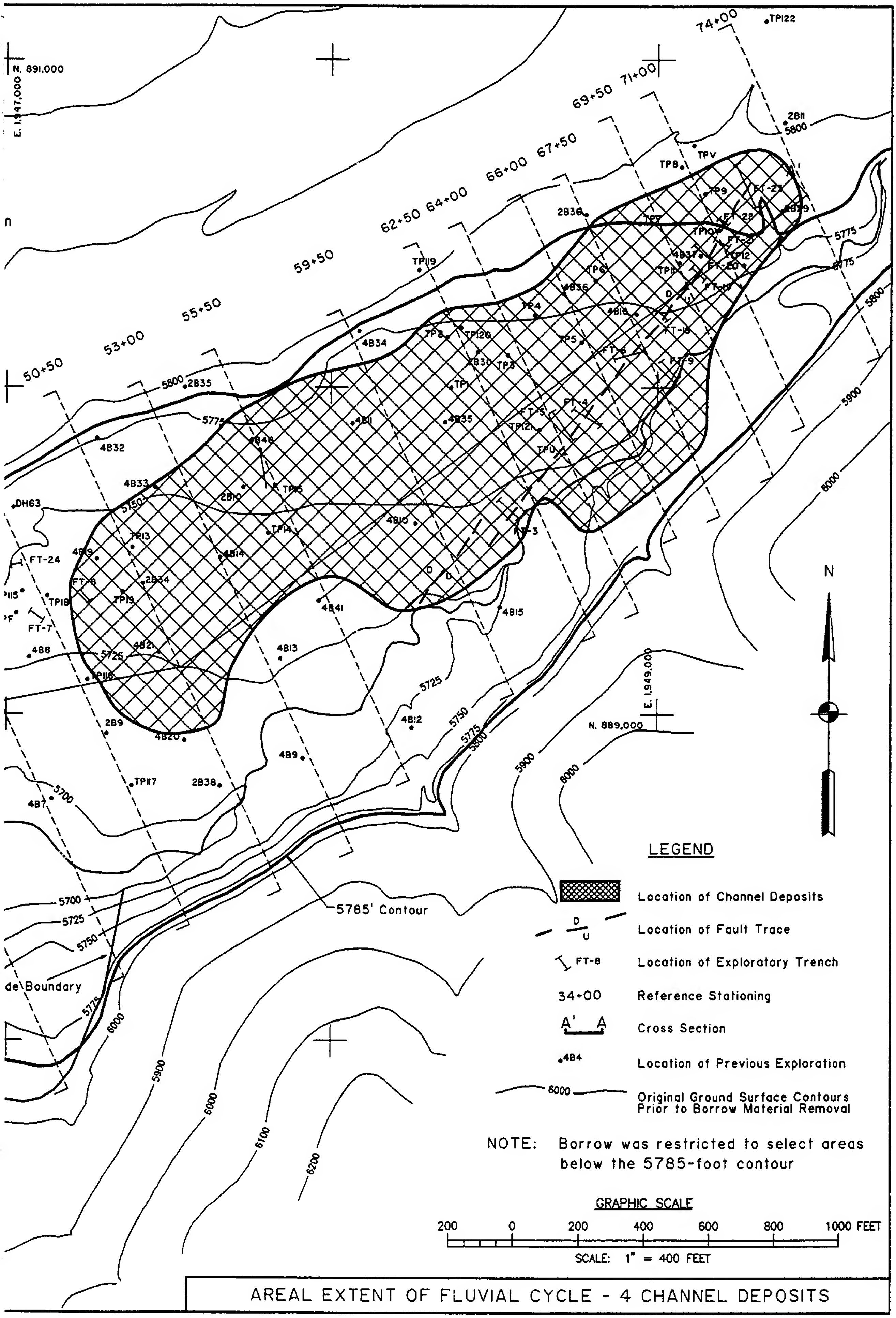
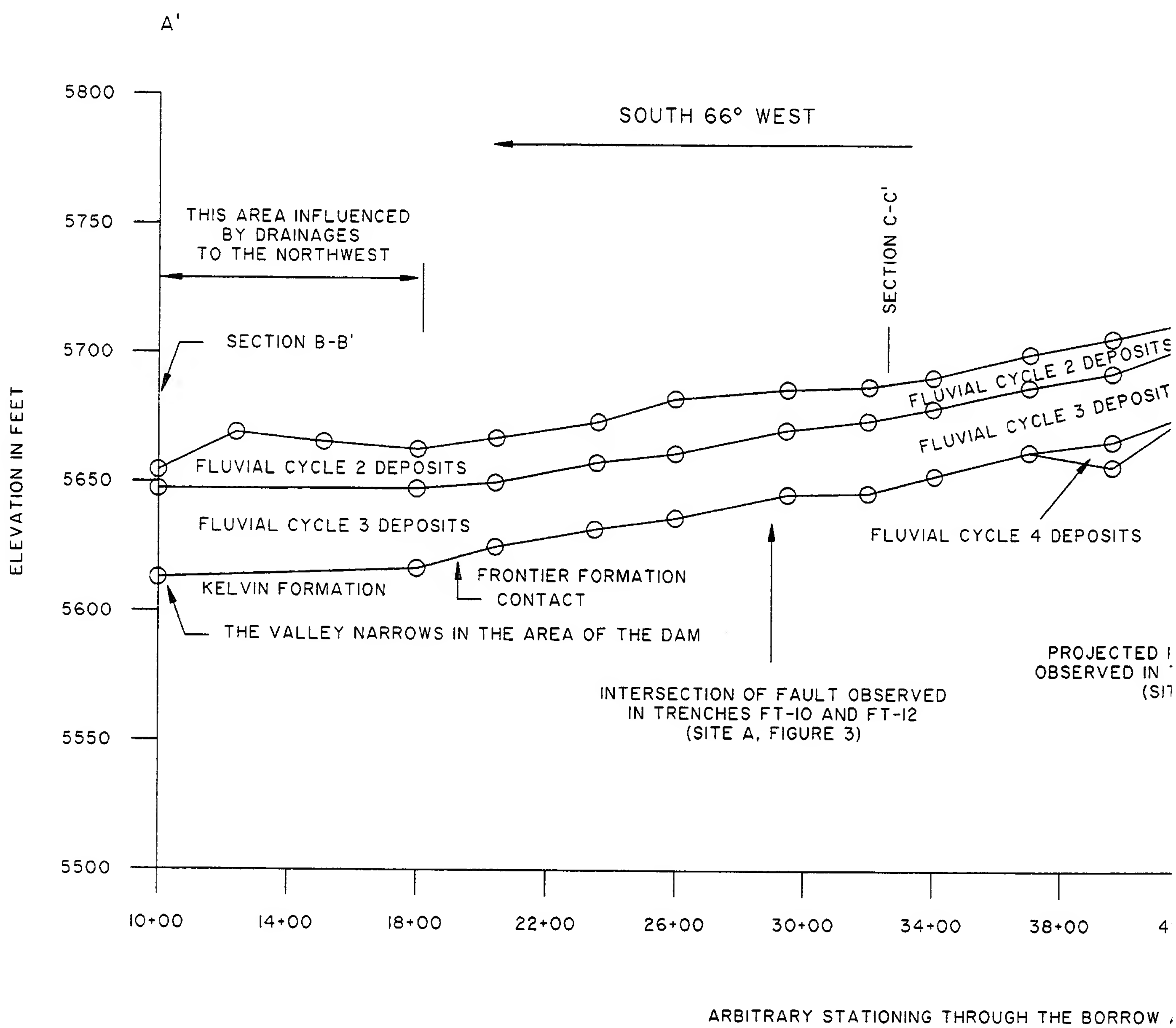


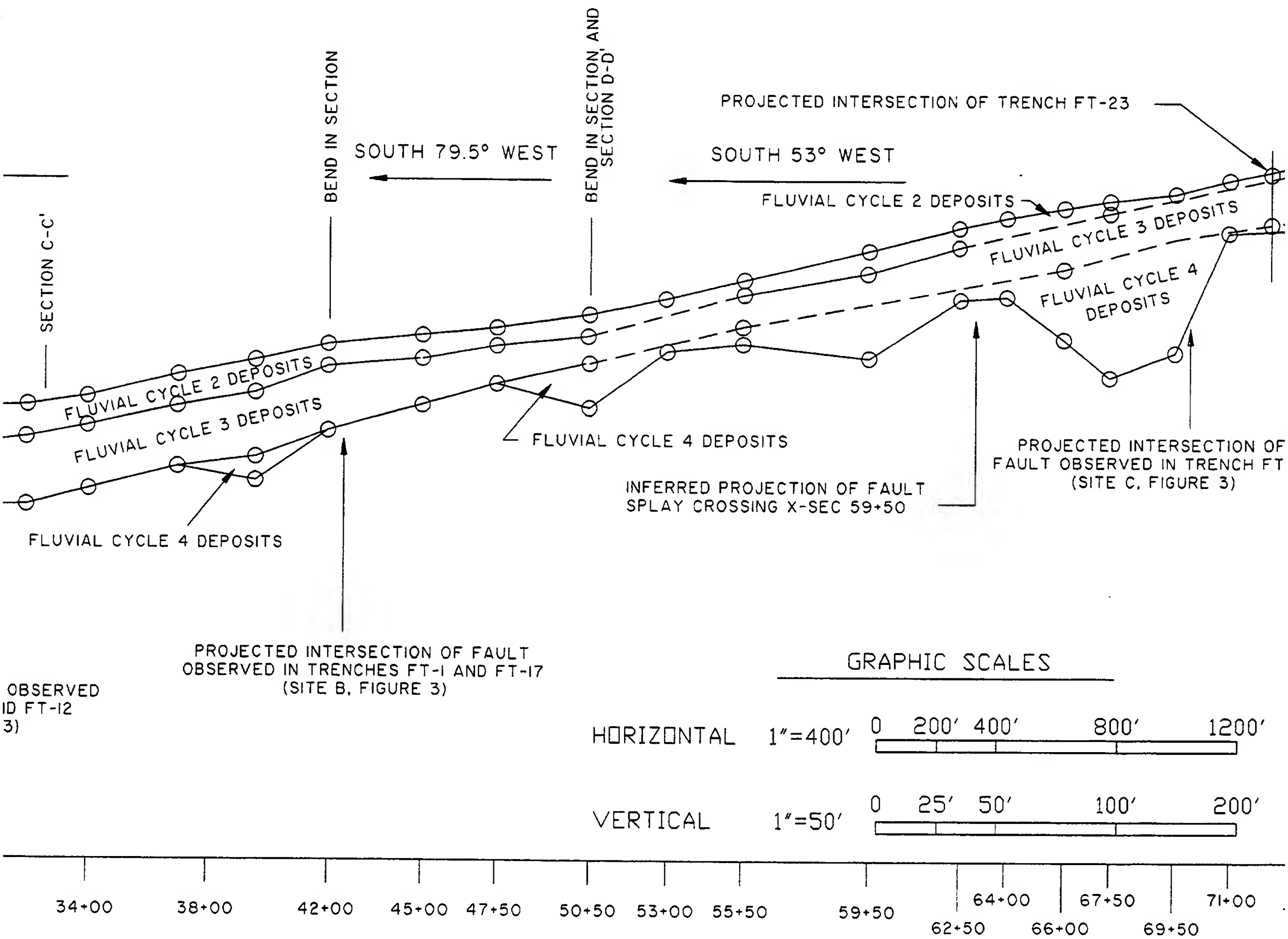
AREAL EXTENT OF FLUVIAL CYCLE - 4 CHANNEL DEPOSITS

FIGURE 8



○ SYMBOL FOR A DATUM POINT

SOURCE: BORROW AREA EXPLORATIONS
LITTLE DELL DAM, UTAH



ATIONING THROUGH THE BORROW AREA (SEE BORROW AREA LOCATION MAP, FIGURE 3)

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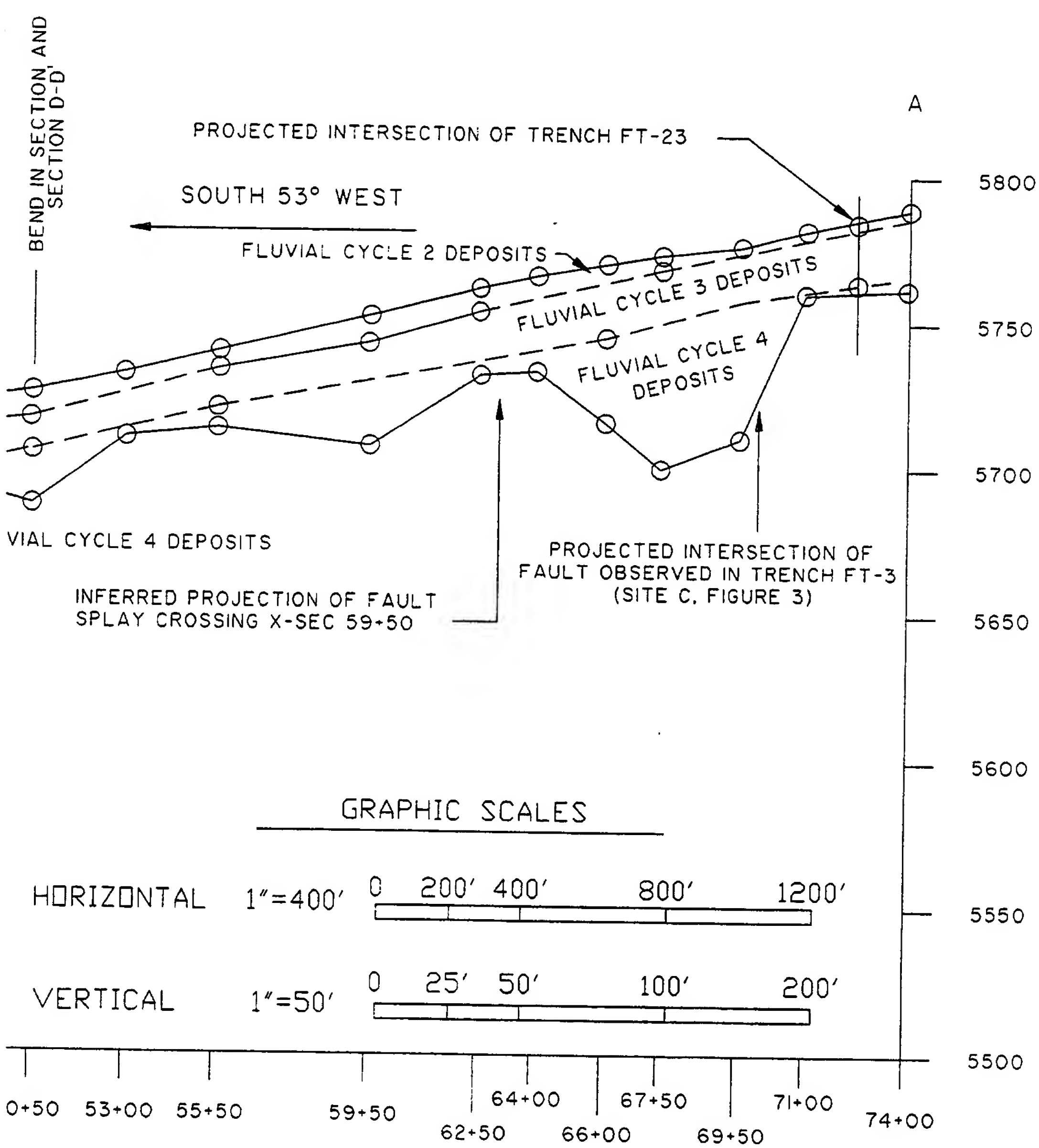
Prepared By: T.W. FEA | Date:



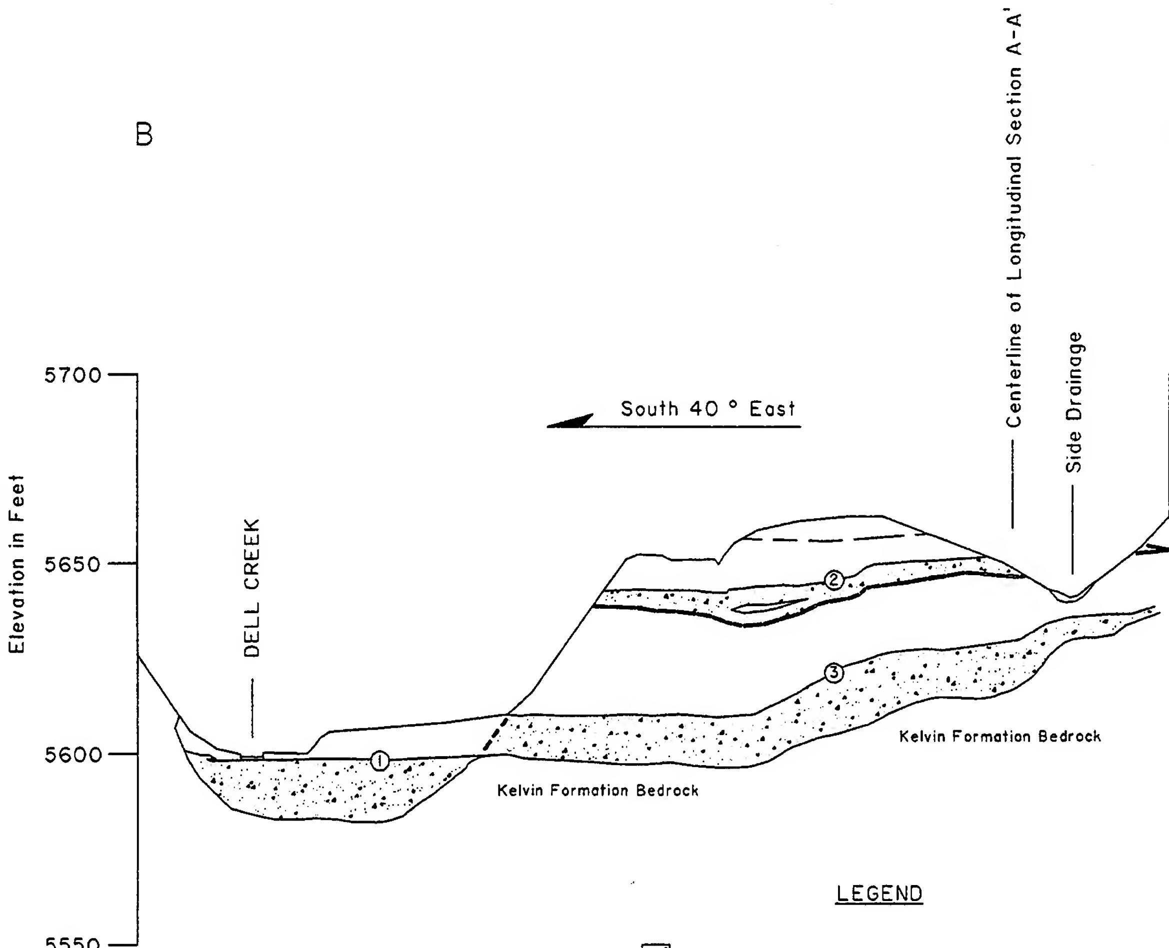
CATION MAP, FIGURE 3)

CAUTION: DRAWING HAS BEEN REDUCED

GENERALIZED LONGITUDINAL SECTION A-A' MAJOR FLUVIAL CHANNEL DEPOSITS LITTLE DELL DAM RESERVOIR AREA, UTAH	
Prepared By: T.W. FEA	Date: December 1992

FIGURE 9

GENERALIZED CROSS SECTION B-B'



LEGEND

- Fluvial Cycle Basal Gravel, Cobble and Boulder Deposits Generally Contains Less Than 30 Percent Fines
- Fluvial Cycle Fine-Grained Deposits Generally Contains More Than 30 Percent Fines
- Geologic Contact Between Fluvial Cycles

DESCRIPTION

① Fluvial Cycle 1 Channel Deposits
② Fluvial Cycle 2 Channel Deposits
③ Fluvial Cycle 3 Channel Deposits
④ Fluvial Cycle 4 Channel Deposits (Not Present)

Horizontal Scale: 1"=150' (0 — 150 Feet)

Vertical Scale: 1"=50' (0 — 50 Feet)

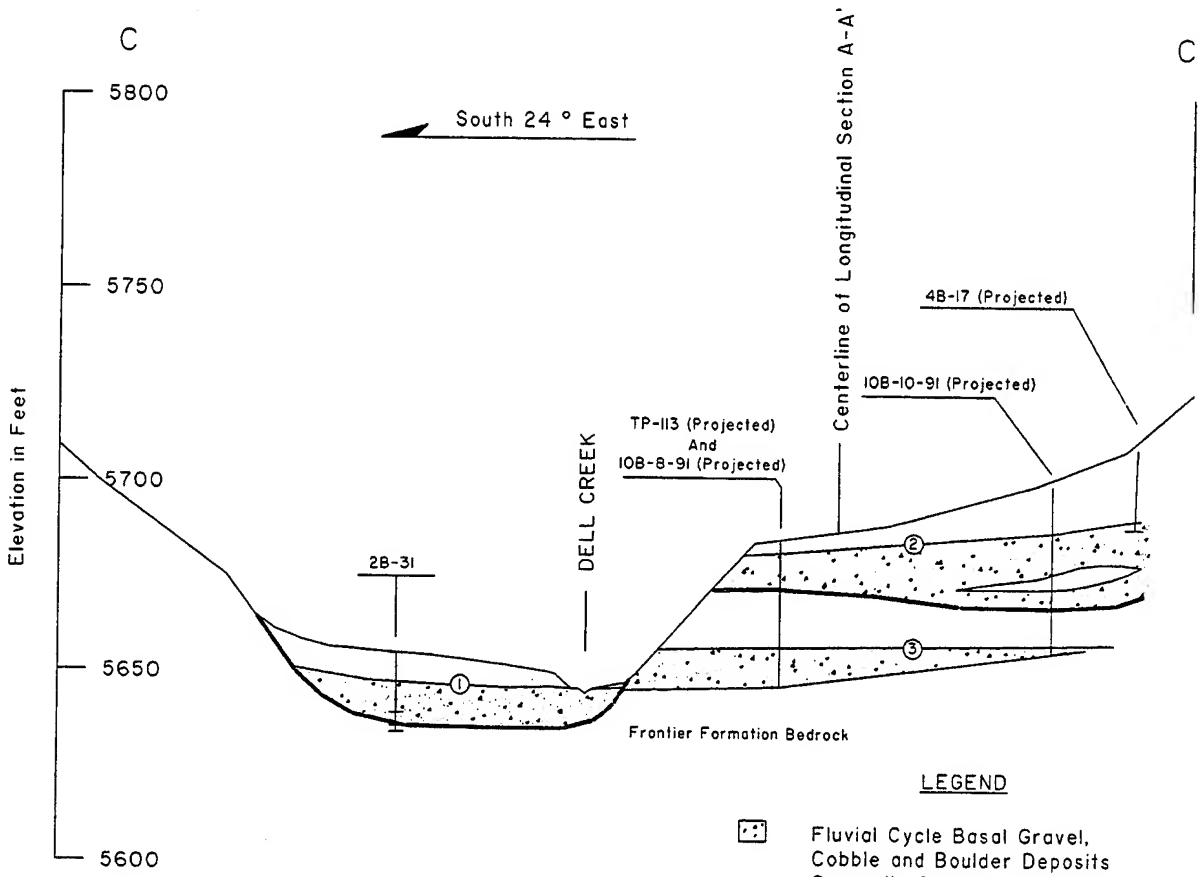
NOTE: 1. Location shown on Figure 3
2. Mapping Accomplished 11/26/88 by:
T.W. Fea P.L. Bever
D.A. Paige J.J. Gewerth

GENERALIZED CROSS SECTION B-B'
MAJOR FLUVIAL CHANNEL DEPOSITS
LITTLE DELL DAM RESERVOIR AREA, UTAH

Prepared by: T.W. FEA	Date: March 1993

Figure 10

GENERALIZED CROSS SECTION C-C'



LEGEND

- Fluvial Cycle Basal Gravel, Cobble and Boulder Deposits Generally Contains Less Than 30 Percent Fines
- Fluvial Cycle Fine-Grained Deposits Generally Contains More Than 30 Percent Fines
- 2B-22 — Bucket Auger Exploration Hole
- 4B-21 — Trench Exploration
- TP-13 — Test Pit Exploration
- 10B-22-91 — Becker Hammer Exploration Hole
- Geologic Contact Between Fluvial Cycles

DESCRIPTION

1. Fluvial Cycle 1 Channel Deposits
2. Fluvial Cycle 2 Channel Deposits
3. Fluvial Cycle 3 Channel Deposits
4. Fluvial Cycle 4 Channel Deposits (Not Present)

NOTE: Location shown on Figure 3

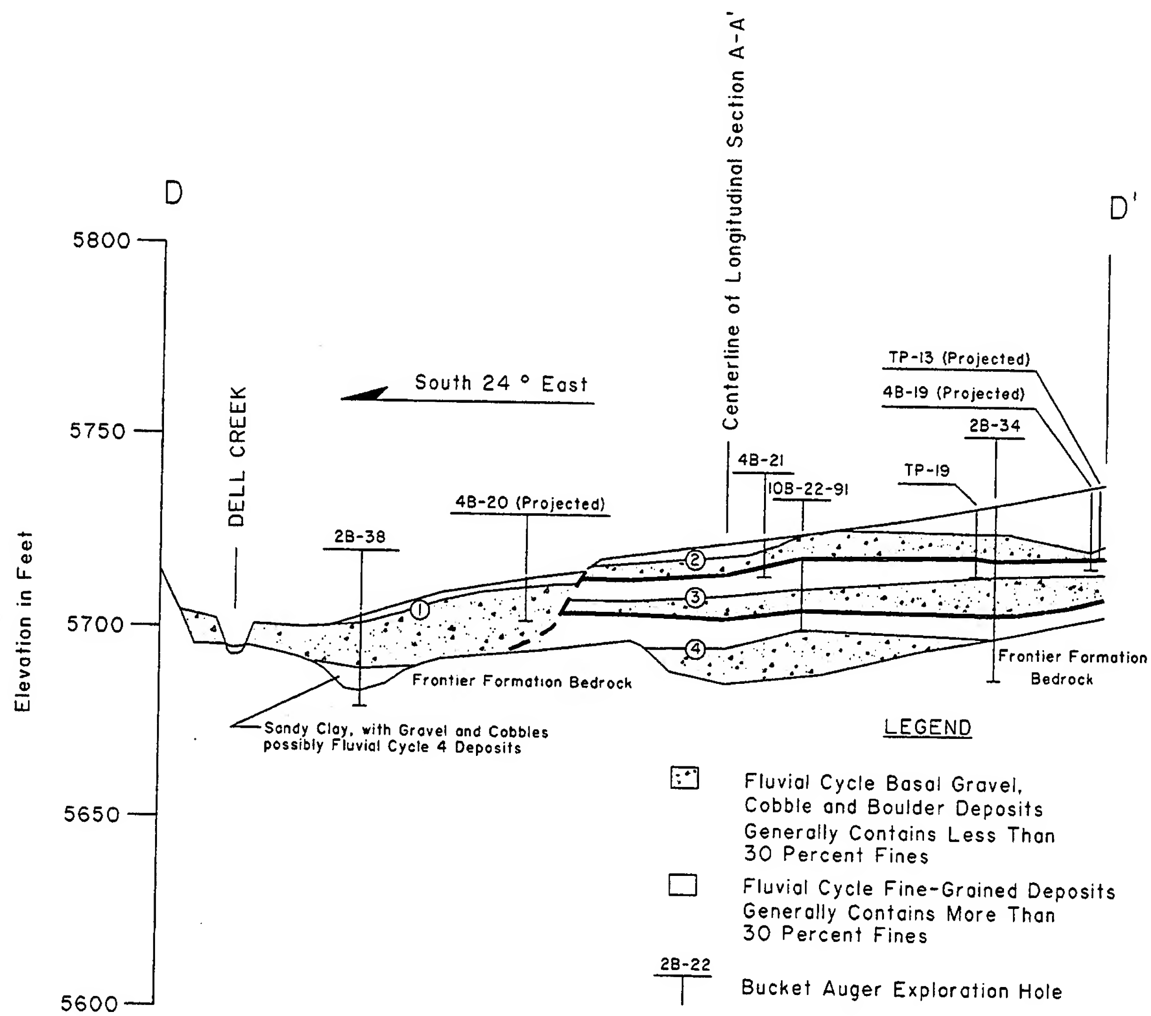
Horizontal Scale: 1"=200'   0 — 200 Feet

Vertical Scale: 1"=50'   0 — 50 Feet

GENERALIZED CROSS SECTION C-C' MAJOR FLUVIAL CHANNEL DEPOSITS LITTLE DELL DAM RESERVOIR AREA, UTAH	
Prepared by: T.W. FEA	Date: March 1992

Figure 11

GENERALIZED CROSS SECTION D-D'



LEGEND

Fluvial Cycle Basal Gravel, Cobble and Boulder Deposits Generally Contains Less Than 30 Percent Fines

Fluvial Cycle Fine-Grained Deposits Generally Contains More Than 30 Percent Fines

2B-22 Bucket Auger Exploration Hole

4B-21 Trench Exploration

TP-13 Test Pit Exploration

10B-22-91 Becker Hammer Exploration Hole

Geologic Contact Between Fluvial Cycles

DESCRIPTION

1. Fluvial Cycle 1 Channel Deposits
2. Fluvial Cycle 2 Channel Deposits
3. Fluvial Cycle 3 Channel Deposits
4. Fluvial Cycle 4 Channel Deposits

Horizontal Scale: 1"=200' 0 200 Feet

Vertical Scale: 1"=50' 0 50 Feet

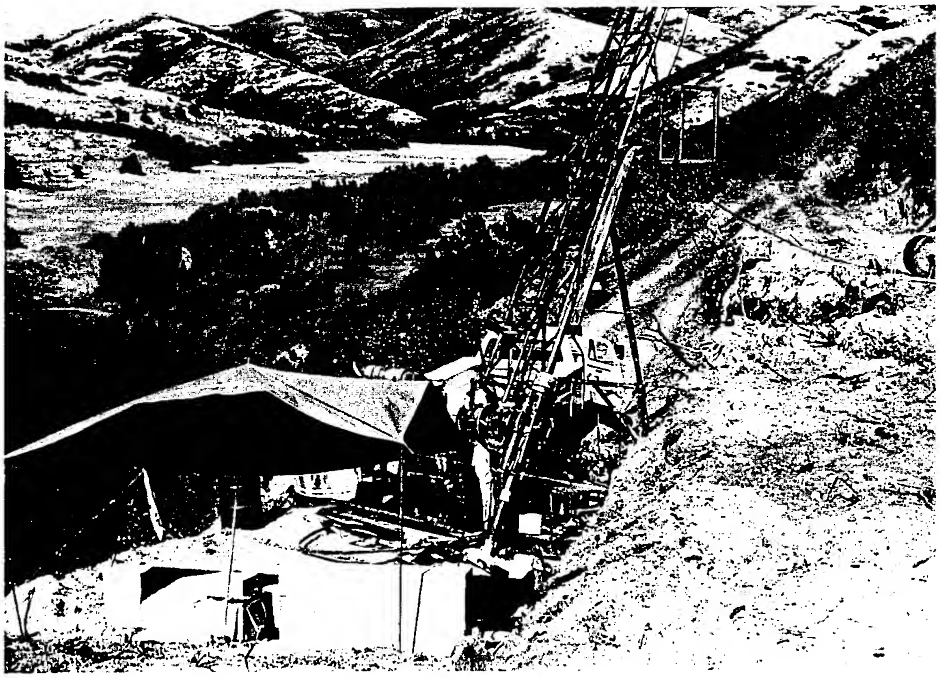
NOTE: 1. Location shown on Figure 3
2. The peizometric surface varies from near-surface to an approximate low elevation of 5690 feet

GENERALIZED CROSS SECTION D-D'
MAJOR FLUVIAL CHANNEL DEPOSITS
LITTLE DELL DAM RESERVOIR AREA, UTAH

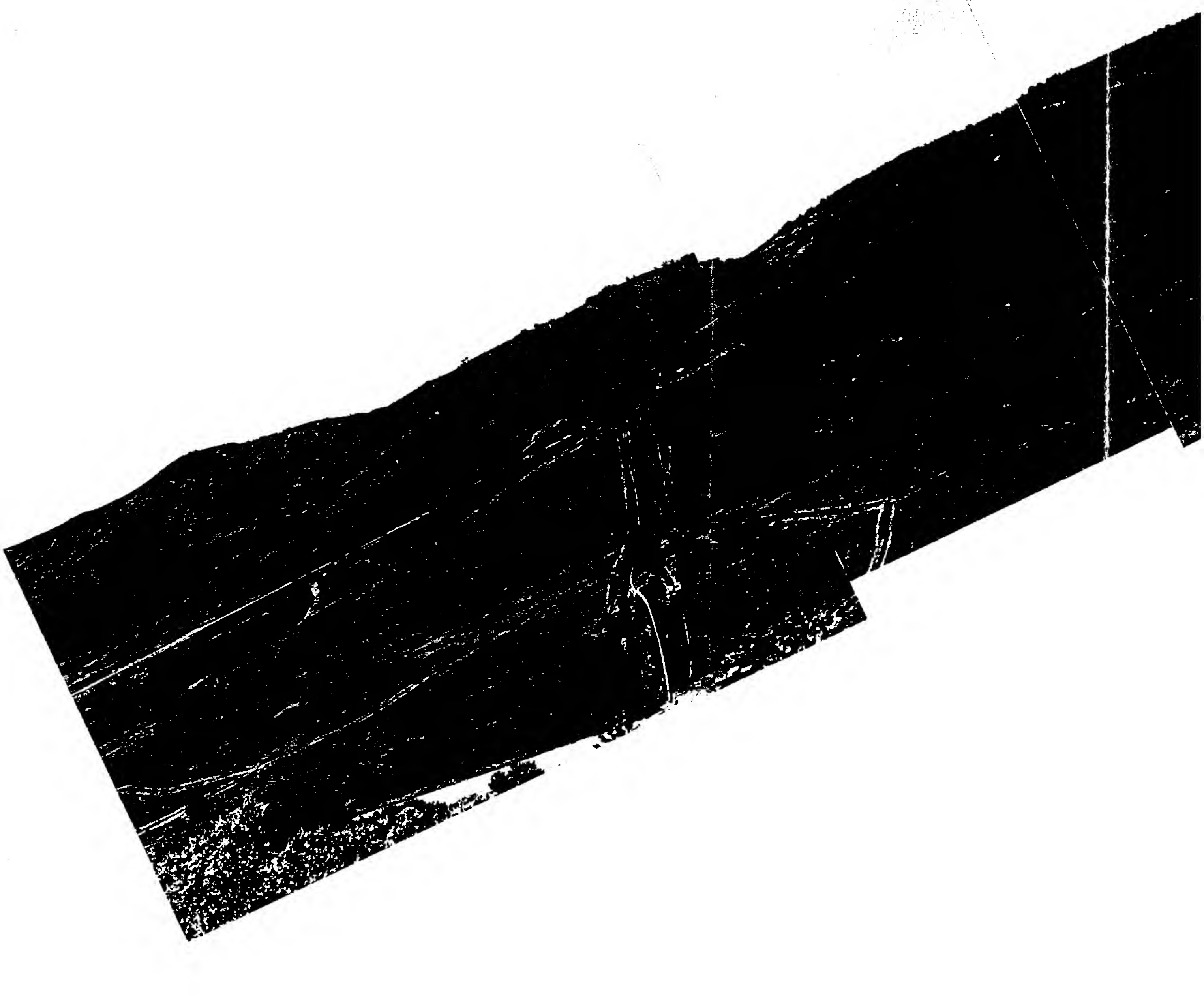
Prepared by: T.W. FEA	Date: December 1992

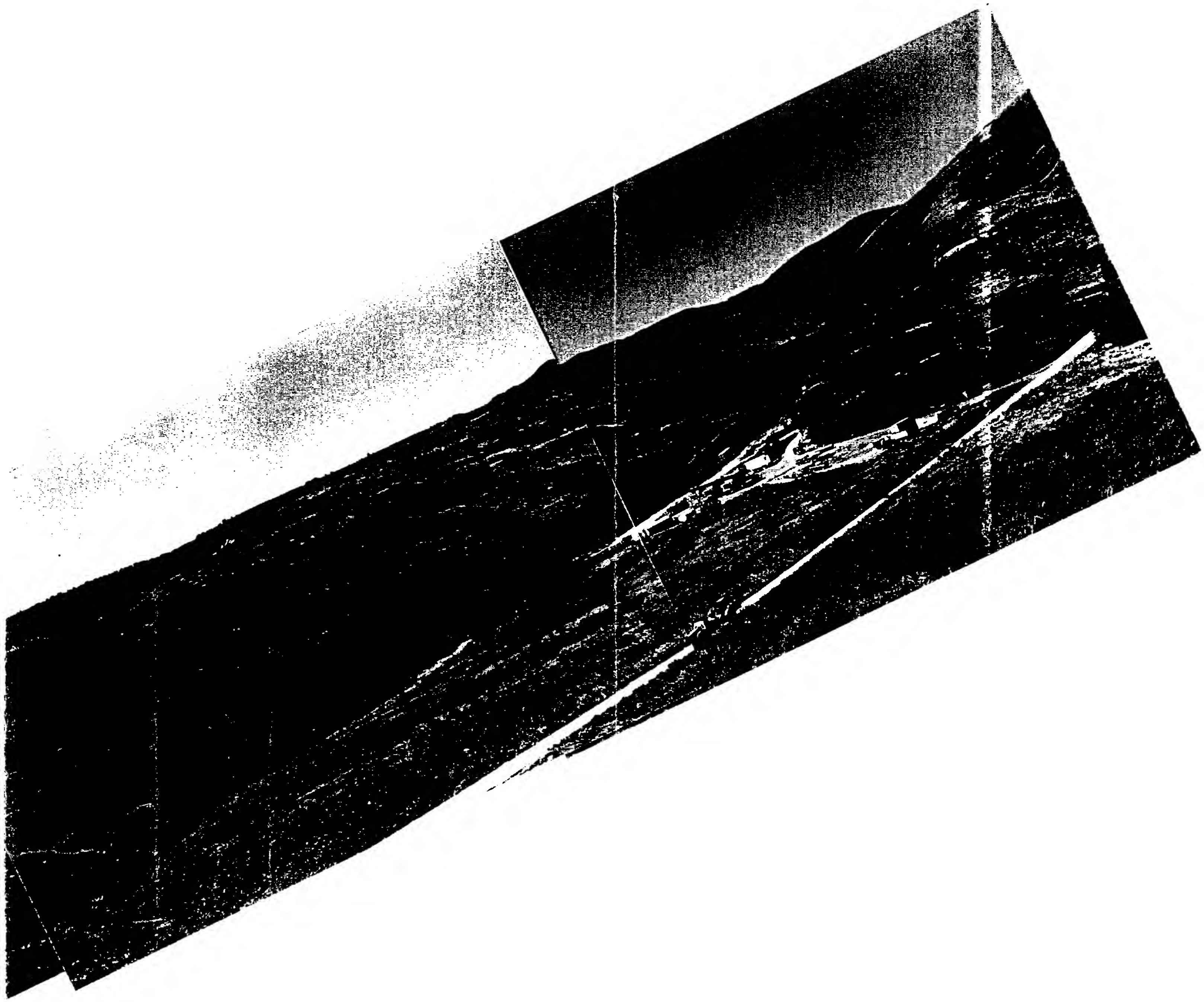
Figure 12

PHOTOGRAPHS



Photograph 1. View of Mountain Dell Canyon prior to dam construction, looking upstream, toward the northeast. The drill rig is located near the present axis of Little Dell Dam, on the left abutment. The broad, flat, grass-covered surface in the upper-left corner of the photograph is an activily farmed terrace formed upon the fining-upward portion of Fluvial Cycle 2 channel deposits. In this view, located in the middle of the photograph approximately 30 to 40 feet lower in elevation, is the more densely vegetated floodplain formed upon Fluvial Cycle 1 channel deposits. Date of photograph is October 1986.





Photograph 2. View of Mountain Dell Canyon looking northwest along the axis of Little Dell Dam (approximate lower one-half of the center of the photograph) from the left abutment prior to core trench excavation. Old State Highway 239 (in the foreground) drops from being constructed upon the Fluvial Cycle 2 terrace deposits to the northeast (right side of the photograph) down upon the Fluvial Cycle 1 floodplain to the southwest (left side of the photograph). The roadcut exposes Fluvial Cycle 2 and Fluvial Cycle 3 channel deposits before encountering the Fluvial Cycle 1 floodplain (also see Generalized Cross Section B-B', Figure 10). In the background, construction for relocating State Highway 239 is on-going, and downstream (left) from the damsite the relocation of the Chevron gas-pipeline is in progress. Date of Photograph is June 1987.

APPENDIX A

BORROW AREA GEOLOGIC STRUCTURE STUDY
LITTLE DELL DAM, UTAH

April 1993

TABLE OF CONTENTS

1. General 1
2. Description of Specific Features and Discussion of Trenches 2
   2.1 Description of Bedrock Step at Trenches FT-1 and FT-2 2
   2.2 Description of Bedrock Step at Trench FT-3 3
   2.3 Description of Bedrock Step at Trench FT-10 6
   2.4 Discussion of Individual Fault Trench Logs 7
3. Other Agency Comments 11
4. Paleontological Investigations and Radiocarbon Dating 11
5. Conclusions 12
6. References 14

ILLUSTRATIONS

Figure 1 General Map
Figure 2 Topographic Location Map - Little Dell Dam Borrow Area
Figure 3-25 Logs of Exploratory Trenches

ATTACHMENTS

A1 Preliminary Discussion of Paleontologic Finds in the Borrow Area - by the Utah State Paleontologist

A2 Report on Radiocarbon Dating of Fluvial Cycle 4 deposits (trench FT-5) - by Beta Analytic Inc.

A3 Report on Radiorcarbon Dating of Fluvial Cycle 3 clay layer (cut-bank near FT-6) - by Beta Analytic Inc.

BORROW AREA GEOLOGIC STRUCTURE STUDY
LITTLE DELL DAM, UTAH

Prepared by Carl E. Cole and Brian A. Bryant
Little Dell Resident Office
U.S. Army Corps of Engineers
Sacramento District

April 1993

1. **General**. During the exploration and design phase of Little Dell Dam, Utah (see General Map, Figure 1), several bedding plane faults were identified in the damsite and in the near-by area. Preconstruction literature searches, inspections of aerial photography, geologic reconnaissances, geologic mapping and seismicity studies all indicated that there was no late Tertiary or Quaternary normal faulting within the dam foundation or the reservoir borrow area. It was, therefore, logically concluded that the existing bedrock faults (reverse sense of displacement) resulted from compressional forces generated during regional mountain building (Laramide Orogeny) which ended about 25 million years before the present (b.p.). These assumptions were generally confirmed during construction of Little Dell Dam when none of the previously identified bedding plane faults were observed to offset any Quaternary deposits in the core trench excavation.

In June 1992, however, two bedrock steps were revealed by excavations in the reservoir borrow area at trenches FT-1 and FT-3 (see Topographic Location Map, Figure 2 for the locations of the trenches and Figures 3 through 25 for the logs of the trenches). In late August 1992, borrow excavations revealed another bedrock step at the location of trench FT-10.

The fluvial channel deposits overlying these bedrock steps also appeared to be displaced along the bedding plane faults which seemingly may have caused the bedrock steps. These faults exhibit a hanging-wall-up (reverse) sense of movement typical of compressional

features but the apparent involvement of the fluvial deposits lead to speculation that the fault movement may have occurred much more recently than 25 million years b.p. Additional trenches were then excavated along the trends of the bedrock steps to further investigate the structures first observed at FT-1, FT-3 and FT-10.

In order to date the latest apparent fault movement, three methods of age assessment were undertaken; paleontological (see Attachment A1), radiocarbon analysis (see Attachments A2 and A3), and stratigraphic correlation. The stratigraphic correlation (USCE, 1993a) has delineated four (4) cycles of fluvial stream channel deposition (Fluvial Cycle 1 being the youngest progressing downward through Fluvial Cycle 4, the oldest). All these dating techniques indicate that several of these fluvial channel deposits, which overlie the faults in and near the damsite, are unbroken, are at least a minimum of 37,000 radiocarbon-years-old, and probably are actually in excess of 100,000 years old.

2. **Description of Specific Features and Discussion of Trenches**. Three specific bedrock-step features were identified in trenches FT-10, FT-1 and FT-3 (in order from downstream to upstream). The following paragraphs discuss the results of and the materials encountered in these investigations, and references the discussion to the fluvial cycles (USCE, 1993a) in which they were deposited.

2.1 **Description of the Bedrock Step at Trenches FT-1 and FT-2**. A bedrock step with approximately 7 feet (2.1 meters) of relief was observed in a dewatering trench during a routine inspection of the borrow area. Trenches FT-1 and FT-2 (see trench logs, Figures 3 and 4) were excavated to further define the nature of the feature. These trenches revealed a sharp contact dipping at about 65 degrees to the southwest between a gray altered and sheared clay bed of the Frontier Formation and the gravelly basal unit of Fluvial Cycle 3. The geometry of the sheared contact suggests that the feature was the result of compressional stresses. All overlying younger materials had been removed before the feature was identified. No shearing could be identified in the basal gravel unit; however, a wedge of green clayey siltstone (shown as circled number 3 on trench log FT-1, Figure 3) appears to have been

squeezed along the contact of the alluvium and the underlying bedrock. Also, several small sharp 1/2 to 1-inch (1 to 3 cm) offsets to the right of "G" on Figure 3 would probably have been eroded had they existed at the time the overlying alluvium was deposited.

Another dewatering trench crossed the trend of the same bedrock step about 150 feet (46 meters) downstream to the southwest. The bedrock step was not seen in this trench.

Trenches FT-14, 15, 16, 17 and 24 (see trench logs, Figures 15, 16, 17, and 18. Note: trench FT-24 was a dewatering trench and was backfilled by the Contractor before it could be logged geologically) were excavated along the northeasternly trend of the step identified in trenches FT-1 and FT-2. The abrupt drop in the elevation of bedrock is more subtle toward the northeast and the observed displacements are smaller. All material younger than the basal unit of Fluvial Cycle 3 had been previously removed except at trench FT-24. This trench revealed the complete sequence of Fluvial Cycle 3 deposits (clay layer overlying the basal gravel) overlying bedrock near the edge of the borrow area. No indication of shearing of the bedrock or offset in the basal unit or in the clay layer of Fluvial Cycle 3 were observed in this trench. Accordingly, it is concluded that the FT-1 bedrock step is of limited areal extent and has caused minor displacements in the lower-most gravel (oldest portion) of the Fluvial Cycle 3 channel deposits.

2.2 **Description of the Bedrock Step in Trench FT-3**. At trench FT-3 (see trench log, Figure 5), during routine mapping of the stratigraphic units, slickensides were observed in the channel deposits of Fluvial Cycle 4 age. It was therefore decided to excavate the trench into bedrock under the alluvium. Observed at this location was a bedrock step that apparently resulted from compressional stresses. Excavation to the limits of the backhoe indicated that the step was greater than 30 feet (9 meters). The step occurs along a sheared and altered bed in the Frontier Formation, and the adjacent and overlying Fluvial Cycle 4 deposits are deformed (Fluvial Cycle 3 deposits had been removed prior to trenching). The bedrock step dips about 65 degrees southeast and bedding in the channel deposits nearly parallels the step, thus suggesting that movement occurred along the bedding plane fault after the fluvial

materials had been deposited.

Overlying the apparent reverse displacement of the bedrock step in trench FT-3 is a flat slip plane along the top of the bedrock (probable landslide plane) showing normal displacement. This scarp appears to be the result of movement along the bedrock-step fault that subsequently triggered a landslide. It also appears that there was probably little additional cover over the Fluvial Cycle 4 deposits at the time of the landslide, for had substantial cover existed, the toe of the scarp would probably have been buttressed against sliding.

Additional trenches and cut-banks were inspected upstream along the trend of the structure observed in FT-3. These exposed additional Fluvial Cycle 4 deposits which were also deformed over the bedrock step. Further, excavation for borrow materials showed the step extending downstream along the trend now shown as a fault trace on the Topographic Location Map (Figure 2). An additional, nearly perpendicular, step was recognized to the northwest of trench FT-3 and appeared to offset or terminate the FT-3 step.

Trenches FT-4 and FT-5 (see trench logs, Figures 6 and 7), upstream and along the bedrock step trend, did not originally encounter bedrock but they did reveal Fluvial Cycle 4 channel deposits tilted about 45 degrees to the northwest. In the absence of any evidence to the contrary, it was assumed that this tilting resulted from the channel deposits being pushed up on the southeast side of the underlying bedrock step. This was later confirmed when the trenches were dewatered and additional Fluvial Cycle 4 materials were removed.

In trench FT-5 (see Figure 7) one of several finer-grained deposits within the basal gravel of Fluvial Cycle 4 was a gray clay containing pieces of wood which were partially decomposed to black organic material. These organics provided a radiocarbon date of greater than 39,000 years b.p. (Beta Analytic, Attachment A-2).

Upstream, along the trend of the FT-3 step, a cut-bank and trench FT-6 (see Figure 8)

revealed an abrupt drop in elevation of the bottom of the Fluvial Cycle 3 channel deposits where they overlie shears in the overbank deposits of Fluvial Cycle 4. One shear was observed at the base of the predominantly coarse-grained material of Fluvial Cycle 3.

Trenches FT-18, 19, 20 and 22 (see trench logs, Figures 19 through 23) revealed the gravelly basal unit of Fluvial Cycle 3 to be in contact with a tilted clay layer that is also judged to be the fining-upward portion of Fluvial Cycle 4 deposits. It is likely that the clay layer was in place when a bedrock-step fault was offset beneath it. In fact, the overlying Fluvial Cycle 3 gravel in trench FT-18 (see Figure 19) appears to have several tilted beds, however, no shearing or offset was observed.

Trench FT-23 (see trench log, Figure 24) was excavated along the upstream edge of the borrow area and across the trend of the FT-3 step. This trench was placed to expose the full sequence of alluvium over a bedrock step. A radiocarbon date of 37,200 $\pm$ 600 years (Beta Analytic, Attachment A-3) was obtained from clayey organic sediments near the base of the fining-upward portion of Fluvial Cycle 3 elsewhere in the borrow area. In trench FT-23, a thin remnant of this clay layer existed at the northwest end of the excavation wall, but did not extend far enough to the southeast to cross the projection of the FT-3 step. However, a faint contact continued across the rest of the trench near the elevation of the missing or eroded clay layer. This contact was formed by an overlying gravel unit of Fluvial Cycle 2 and an underlying gravel unit of Fluvial Cycle 3.

The Fluvial Cycle 3 gravel extended the full depth of the backhoe reach across the northwest two-thirds of trench FT-23 to a point near the projection of the FT-3 step where a lower clay layer was encountered. This clay layer appeared similar to the tilted clay layer thought to form the contact between Fluvial Cycle 4 and Fluvial Cycle 3 materials in trenches FT-18 through FT-22. Samples of this clay, taken from the teeth of the backhoe bucket, were similar to those of the clay in the other trenches and contained well-defined polished surfaces with slickensides. No shearing was apparent in any of the Fluvial Cycle 3 and Fluvial Cycle 2 deposits overlying the contact with this Fluvial Cycle 4 clay layer.

2.3 **Description of the Bedrock Step at Trench FT-10**. Trench FT-10 (see trench log, Figure 11) shows an abrupt 4 to 5-foot (1.2 to 1.5 meters) overhang at the contact of the bedrock with the basal gravel of Fluvial Cycle 3. No offset was seen in the Fluvial Cycle 3 gravel, although there was some soft, sheared bedrock observed around several of the cobbles, indicating that displacement may have occurred after the gravel was deposited.

A routine inspection of a near-by excavated bank revealed a small bedrock step that juxtaposed at a steep angle the coarse-grained basal unit of Fluvial Cycle 3 against sheared bedrock. The small step initially appeared to have been a result of offset with hanging-wall-up (reverse) sense of movement indicative of compressional stresses. However, the area was excavated (but not geologically logged), and the deepened exposure showed the contact becoming inclined in the opposite direction at a low angle. This feature was thus shown to be of depositional origin. This example points out that local bedrock relief of at least five (5) feet (1.5 meters) is a common depositional feature and is, therefore, not inherently tectonic in origin.

Trench FT-25 (see trench log, Figure 25) was excavated across the projection of the FT-10 step near the northwest edge of the borrow area. An undulation of about 1-foot (0.3-meter) was exposed at the contact between the overbank clay deposits and the basal gravel of Fluvial Cycle 4. As observed at other locations, this is well within the variance expected for a fluvial contact. Small slickensides occur both over and upstream from the bedrock undulation.

Therefore, the bedrock step seen in trench FT-10 (Figure 11) does not continue toward the dam. Rather, it too is of limited extent and is comparable to the other bedrock step faults in the dam and reservoir borrow area.

2.4 <u>Discussion of Individual Fault Trench Logs</u>:

<u>FT-1 (Figure 3)</u>: Bedrock is overlain by the basal gravel of Fluvial Cycle 3 with an apparent vertical bedrock offset of approximately 4 to 5 feet (1.2 to 1.5 meters). In addition, several small, abrupt bedrock displacement of 1/2 to 1-inch (1 to 3 centimeters) were also observed. Altered claystone appears to be squeezed adjacent to the contact with the gravel suggesting a compressional stress condition. No shearing or offset is observed in the Fluvial Cycle 3 basal gravel above the bedrock step.

<u>FT-2 (Figure 4)</u>: Bedrock is overlain by the basal gravel of Fluvial Cycle 3 with an apparent vertical bedrock offset of approximately 3 to 4 feet (1 to 1.2 meters). Shearing is within an altered claystone bed.

<u>FT-3 (Figure 5)</u>: Bedrock has been offset with respect to the coarse channel fill of Fluvial Cycle 4 a minimum of 30 feet (9 meters). Offset is along a partially altered tuffaceous sandstone bed. Channel fill adjacent to the shear has apparent drag fold features with bedding dipping away from the offset, and offset bedding blocks are contained within the alluvium. Fault offset appears to be the result of compression, with Cretaceous bedrock thrust over the alluvium. A small landslide feature offsets the fault approximately 2 feet (0.6-meter) which suggests that a limited alluvial section was in place at the time of movement.

<u>FT-4 (Figure 6)</u>: Fluvial Cycle 4 channel fill appears to have been pushed up along a suspected underlying step in the bedrock creating a partially folded exposure. The remainder of the fold was removed during borrow excavation. Shearing is present within the deposits of Fluvial Cycle 4.

<u>FT-5 (Figure 7)</u>: Fluvial Cycle 4 channel fill has been deformed along an underlying step in the bedrock which was exposed during excavation after the trench was geologically logged. A folded organic-rich bed in the fluvial deposits was radiocarbon dated at

greater than 39,000 years (Beta Analytic, Attachment A-2). Shears in the fluvial deposits have a minimum offset of about 15 feet (4.6 meters).

FT-6 (Figure 8): Fluvial Cycle 4 overbank deposits are sheared, apparently caused by movement of an underlying bedrock step (fault). Deformation of Fluvial Cycle 3 gravel deposits may have occurred. Total offset along the contact of the Fluvial Cycle 3 basal gravel with the Fluvial Cycle 4 overbank deposits is approximately 5 to 6 feet (1.5 to 1.8 meters).

FT-7 (Figure 9): The trench contains a bedrock fault in contact with a gravel bed of Fluvial Cycle 3. There is no conclusive evidence indicating if the contact of the fluvial deposits with the fault is depositional or tectonic.

FT-8: **This trench was not logged** due to groundwater filling.

FT-9 (Figure 10): The trench log shows a depositional contact between basal gravel of Fluvial Cycle 4 and bedrock of the Frontier Formation.

FT-10 (Figure 11): The trench log shows an abrupt overhanging contact between bedrock and the basal gravel of Fluvial Cycle 3. The vertical bedrock offset is 3 feet (1-meter) and shearing is within an altered claystone bed. No displacement was observed in the gravel above the bedrock offset. However, soft sheared bedrock was observed around several cobbles, suggesting that the fluvial deposits were in-place when shearing occurred.

FT-11 (Figure 12): The trench log shows a depositional contact between basal gravel of Fluvial Cycle 3 and the fine-grained overbank deposits of Fluvial Cycle 3. No shearing or offset was observed along the contact.

FT-12 (Figure 13): Two distinct shear zones are present in the bedrock exposed in this

trench. The easterly bedrock shear appears thrust above the basal gravel of Fluvial Cycle 3 with an approximate vertical offset of 2 feet (0.6-meter). The shearing appears to be along bedding within a moderately hard sandstone and not within an altered claystone. The second shear (near "F" on Figure 13) has an approximate vertical offset of 2 to 3 feet (0.6 to 1-meter). Again, the altered claystone has a squeezed appearance beneath the present position of the gravel. Both shears suggest compressional stress.

FT-13 (Figure 14): The entire trench was in basal gravel of Fluvial Cycle 4 to an approximate depth of 20 feet (6.1 meters). No distinctive feature was noted.

FT-14 (Figure 15): Relatively small-scale bedrock shears were present in this trench with a maximum offset of 2 to 4 inches (5 to 10 centimeters). Shearing was within a sandstone bed and no offset or shears were observed in either the overlying basal gravel or the fining-upward sequence of the Fluvial Cycle 3 deposits.

FT-15 (Figure 16): Relatively small-scale bedrock shears were present in this trench similar to those in FT-14, except the shears were in clayey bedrock. Small offsets of about 2 inches (5 centimeters) were observed at the bedrock contact with Fluvial Cycle 3 gravel.

FT-16 (Figure 17): The trench log shows a depositional contact between bedrock and the basal gravel of Fluvial Cycle 3. No shears or offset of alluvium was observed.

FT-17 (Figure 18): Several shears were observed in the bedrock with three (3) of them creating a 1 to 2-foot (0.3 to 0.6-meter) bedrock step overlain by basal gravel of Fluvial Cycle 3. The gravel was not displaced. Shearing is generally along bedding within an altered claystone or other fine-grained rock, with the dip of the shears varying slightly.

FT-18 (Figure 19): Fine-grained overbank deposits of Fluvial Cycle 4 are overlain by what appears to be thick channel deposits of Fluvial Cycle 3 basal gravel. No shearing was observed within the basal gravel; however, the fine-grained beds within Fluvial Cycle 3 appear to have been pushed up and deformed similar to that of the underlying Fluvial Cycle 4 clays. Total deformation appears to be approximately 20 feet (6.1 meters). Shears with polished surfaces and down-dip striae were observed in the fine-grained Fluvial Cycle 4 deposits.

FT-19, 20, 21 and 22 (Figures 20, 21, 22, and 23): Generally, the same relationships as were observed in trench FT-18 were seen in FT-19, 20, 21 and 22.

FT-23 (Figure 24): This trench is in alignment with folded fluvial deposits and the observed bedrock steps. Fine-grained deposits of Fluvial Cycle 4, observed in nearby trenches, are exposed on the bottom of this trench with the same sheared characteristics. This lowermost fine grained deposit is probably Fluvial Cycle 4 overbank deposits in contact with the overlying basal gravel of Fluvial Cycle 3. Several gravel beds and an overlying fine-grained deposit of limited areal extent comprise Fluvial Cycle 3 and are in contact with an upper gravel judged to be of Fluvial Cycle 2. Deposits of Fluvial Cycle 3 and Fluvial Cycle 2, including its near-surface soil horizon, show no offset or shearing.

FT-24: This trench was a dewatering trench and was backfilled by the Contractor before it could be geologically logged. The fining-upward portion of Fluvial Cycle 3 had an apparent step. However, close examination showed the step to be a depositional contact with an overlying gravel bed of Fluvial Cycle 2. None of these deposits were deformed.

FT-25 (Figure 25): This trench exposed the contact between the fining-upward overbank deposits and the underlying basal gravel of Fluvial Cycle 4. Generally, it is an undulatory depositional contact with a slightly higher area in the eastern portion of the

trench which also has discontinuous, randomly-oriented polished surfaces with striations near the contact.

3. **Other Agency Comments**. The Utah Geologic Survey (UGS), Utah Department of National Resources, Dam Safety Section, and the U.S. Bureau of Reclamation (USBR) were invited to inspect the excavated slip surfaces. Utah Dam Safety Section collected information but made no recommendations. Gary Christiansen (UGS) had numerous conversations with Carl E. Cole (Project Geologist) concerning the observations, and other representatives from the UGS visited the site to inspect the features. Mr. Christiansen and others from UGS felt that the slip surfaces were most likely the result of large-scale gravity movement, primarily because this area has been under tensional stress since the mid-Tertiary and no other examples of compressional tectonic slip have been identified. Dean Ostenaa of USBR also felt that it is unlikely to have compressional features after mid-Tertiary time. He suggested that the alluvium may be very old and pointed out that unconsolidated alluvium has ranges in age from an estimated 70,000 to 1.6 million years at the Jordanelle Project about 40 miles (64 km) southeast of Little Dell Dam.

4. **Paleontological Investigations and Radiocarbon Dating**. Quaternary age fossils, including bones from several large animals in the size range of elk or moose (not bison) and probably the extinct zebrine horse, bones of many small animals, mostly extinct rodents and a part of a large mastodon tusk were found within the reservoir borrow area. Many of the bones and the tusk were recovered from trench FT-5 (see Figure 7) and were within the basal channel deposits of Fluvial Cycle 4. Other bones of large mammals were found in an intermediate clay layer of Fluvial Cycle 3 near trenches FT-24 and FT-8. The bones were given to the Utah State Paleontologist, David Gillette, for further assessment. His preliminary observations are appended as Attachment A-1. In general, the bones are from mammals of Pleistocene age and hence are judged to be between 11,000 and 1,000,000 years old.

The Little Dell staff collected carbon samples from two (2) fluvial strata; specifically from (1) woody black organic beds within the basal channel deposits of Fluvial Cycle 4 in

trench FT-5 (see Figure 7), and (2) from some black mucky organic fines found near the base of Fluvial Cycle 3 overbank deposits. The second sample location was a cut-bank in the middle of the borrow area, near bucket auger hole 4B-21. Both these samples were submitted to a commercial laboratory (Beta Analytic) and the test results are appended as Attachments A-2 and A-3. The material from the basal channel deposits of Fluvial Cycle 4 (in FT-5) was dated at greater than 39,000 years, the approximate upper limit of dates obtainable by normal radiocarbon assay. The material from the base of the Fluvial Cycle 3 overbank clay layer was dated as 37,200 $\pm$600 years old. Both of these dates are likely to be minimum ages for the respective channel deposits owing to the potential of contamination caused by contemporary groundwater flow (organic acids) passing through these sediments.

5. **Conclusions**. Quaternary-age faulting has occurred in the reservoir borrow area. Displacement, mainly from compressional forces, is indicated by the association of bedrock steps and reverse faults, bedrock shear zones, and the deformed overlying channel deposits of both Fluvial Cycle 4 and the basal portion of Fluvial Cycle 3. The evidence for this Quaternary offset is well exemplified in trench FT-3 (Figure 5). This evidence consists of the following observations:

1. Fluvial deposits in the walls of trench FT-3, adjacent to a bedrock step (fault) in the Frontier Formation have a hanging-wall-up (reverse) sense of movement and exhibit distorted, near-vertical bedding.

2. Immediately overlying the bedrock step and the faulted sediments is a normal fault plane (probably an ancient landslide deposit now buried) which is also contained within the Fluvial Cycle 4 deposits.

3. These fault displacements are observed in other trenches as distorting sediments throughout the entire depositional sequence of the Fluvial Cycle 4, the oldest of the four (4) fluvial cycles identified as overlying bedrock in the reservoir borrow area.

4. In other trenches (FT-1, 2, and 10) there are minor displacements noted in the lowermost portion of the basal gravel of Fluvial Cycle 3 (the next youngest depositional sequence), but these do not extent upward through the gravel into the overbank deposits.

The trench investigation revealed no evidence of faulting in sediments younger than the basal gravel of Fluvial Cycle 3. The age of the Fluvial Cycle 3 gravel is probably in excess of the 37,200 $\pm$600 years b.p. radiocarbon date, owing to probable contamination of the sample by groundwater containing younger organic acids. Also, the stratigraphic position of the observed displacements are well below the base of the overbank deposits of Fluvial Cycle 3 where the radiocarbon-dated deposit was obtained. This date, plus an age assessment of fluvial channel deposits based on regional climatic and sedimentologic change (USCE, 1993a) indicate that unfaulted Fluvial Cycle 3 deposits are older than the 35,000-year "last displacement criterion" required by the Corps of Engineers for determining that a fault is active (capable). Accordingly, all presently available evidence indicates that the bedrock faults in the reservoir borrow area are not active (capable), do not project toward the Little Dell Dam, and are not a potential hazard.

All presently-available data suggest that two alternative hypotheses may reasonably explain the origin of the bedrock structures and the timing of faulting in the reservoir borrow area. They are:

1. The bedrock steps may be the result of compressional shearing associated with intrablock stresses within a larger normal fault block.

2. The bedrock steps may be the result of a large gravity feature, possibly from rotation along weak beds within the Parley's Canyon Syncline.

However, the validity of either hypothesis would require investigations far beyond the level of this study and would not reasonably add information immediately pertinent to the design or

safety of Little Dell Dam.

6. **References**:

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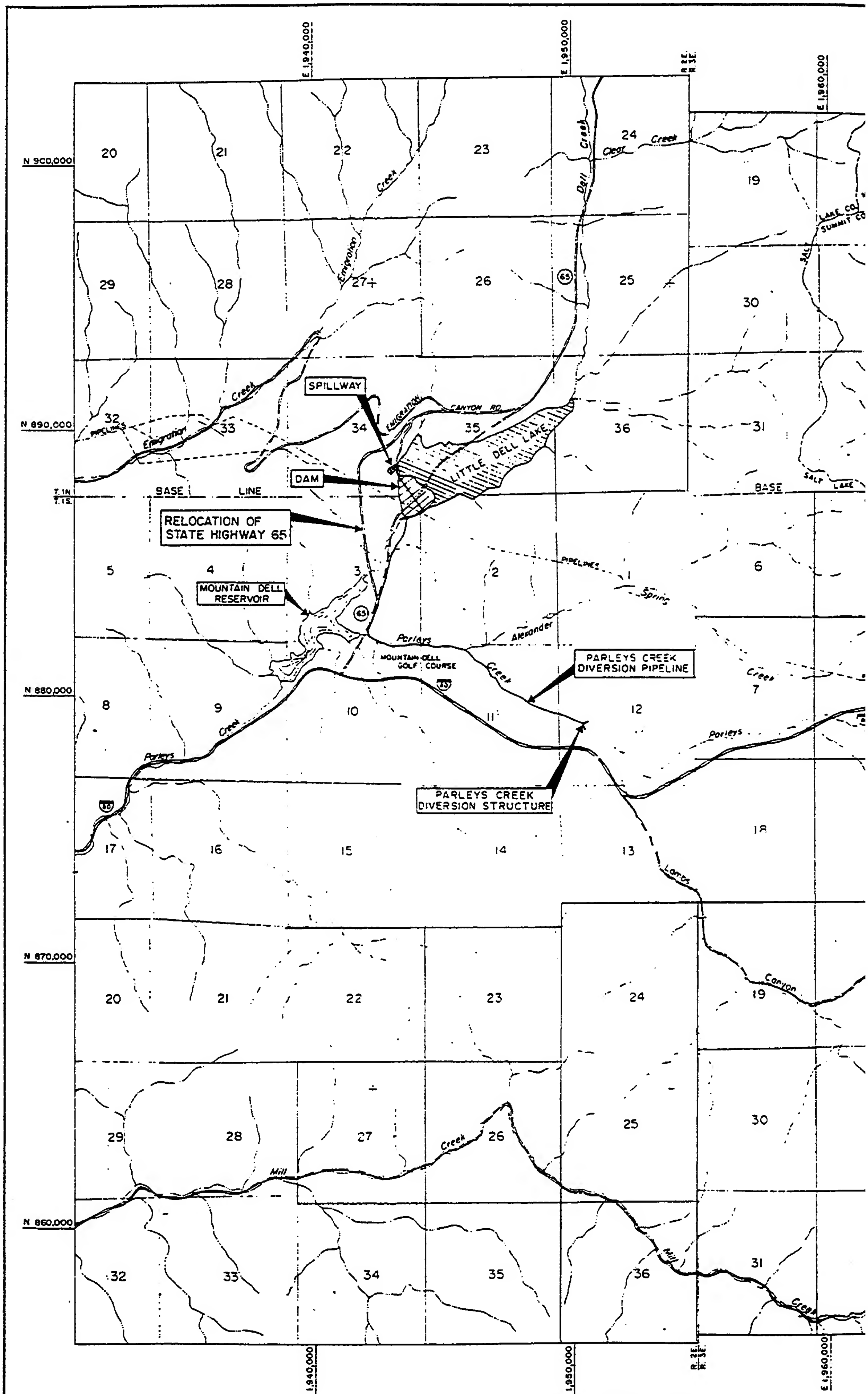
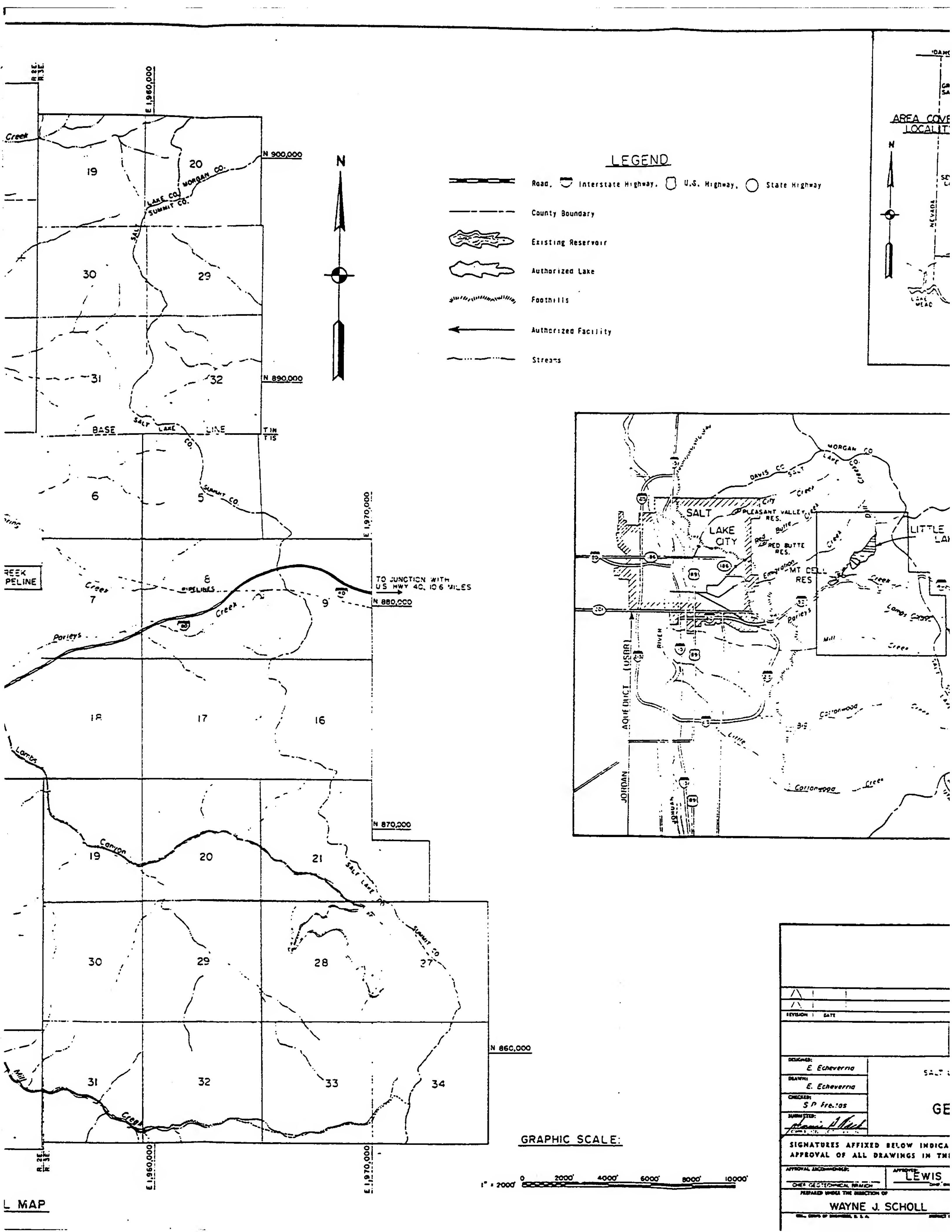
ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



GENERAL MAP



LEGEND
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Foothills
Authorized Facility
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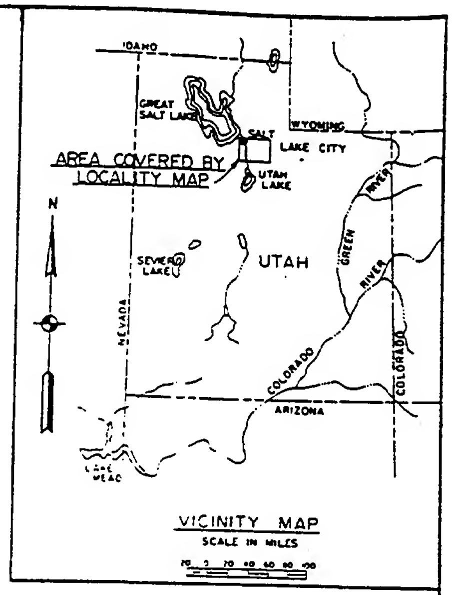
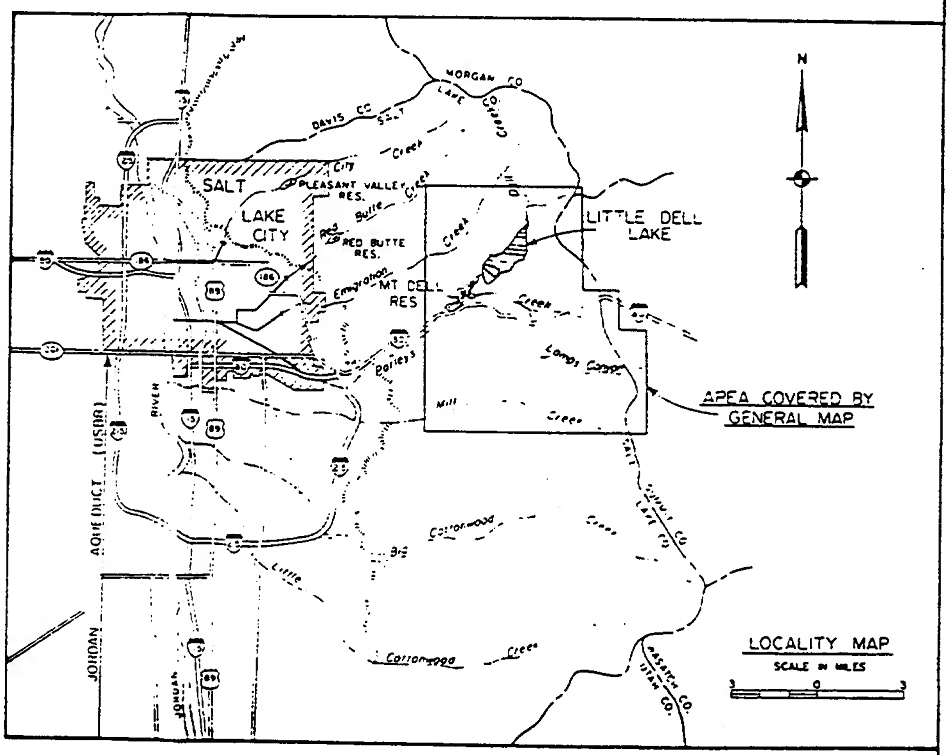
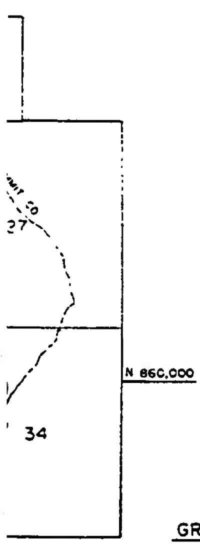
SUMMIT CO.
SALT LAKE CO.
TO JUNCTION WITH U.S. HWY 40, 10.6 MILES
PIPELINES
Parleys Creek
Lambs Canyon
Mill Creek
CREEK PIPELINE
SALT LAKE CITY
PLEASANT VALLEY RES.
RED BUTTE RES.
MT DELL RES
LITTLE
DAVIS CO.
JORDAN AQUEDUCT (USBR)
JORDAN RIVER
Emigration
Cottonwood Creek
GRAPHIC SCALE:
1" = 2000'
0 2000' 4000' 6000' 8000' 10000'
REVISION DATE
DESIGNED: E. Echeverria
DRAWN: E. Echeverria
CHECKED: S P Freitas
SUBMITTED:
SIGNATURES AFFIXED BELOW INDICA
APPROVAL OF ALL DRAWINGS IN THE
APPROVAL RECOMMENDED:
CHIEF GEOTECHNICAL BRANCH
APPROVED: LEWIS
PREPARED UNDER THE DIRECTION OF
WAYNE J. SCHOLL
GE
L MAP

LEGEND

- Road, Interstate Highway, U.S. Highway, State Highway
- County Boundary
- Existing Reservoir
- Authorized Lake
- Foothills
- Authorized Facility
- Streams







GRAPHIC SCALE:

1" = 2000' 0 2000' 4000' 6000' 8000' 10000'

REVISION	DATE	DESCRIPTION	BY	BY

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: E. Echeverria
DRAWN: E. Echeverria
CHECKED: S P Freitas
SUBMITTED:

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

GENERAL MAP

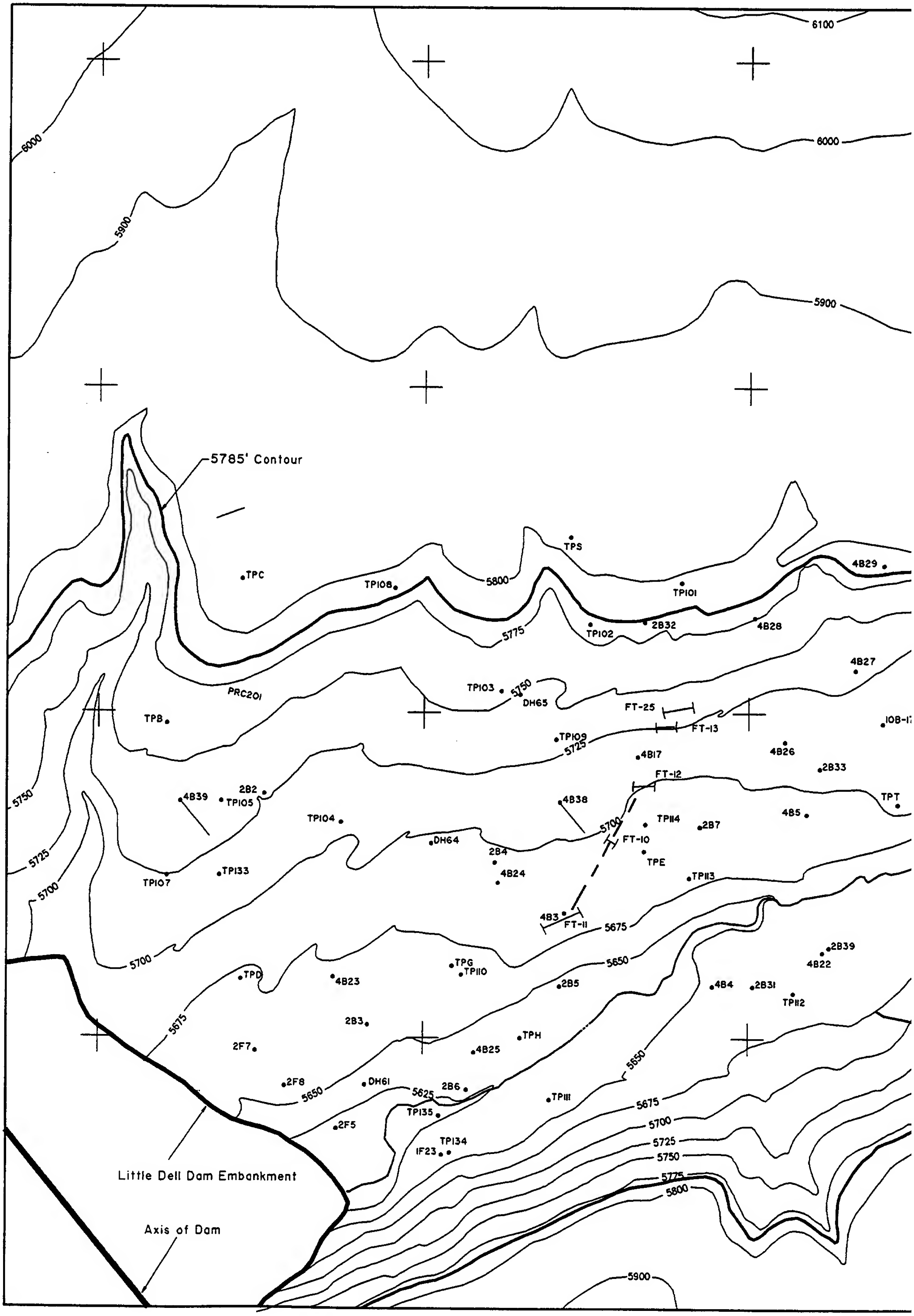
SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDEXED ON THIS SHEET

APPROVAL RECOMMENDED:
CHIEF GEOTECHNICAL BRANCH
APPROVED: LEWIS A. WHITNEY
DATE:

PREPARED UNDER THE DIRECTION OF
WAYNE J. SCHOLL

SCALE: AS SHOWN
SHEET 1

Figure 1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DH65
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TP107
TP133
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TP113
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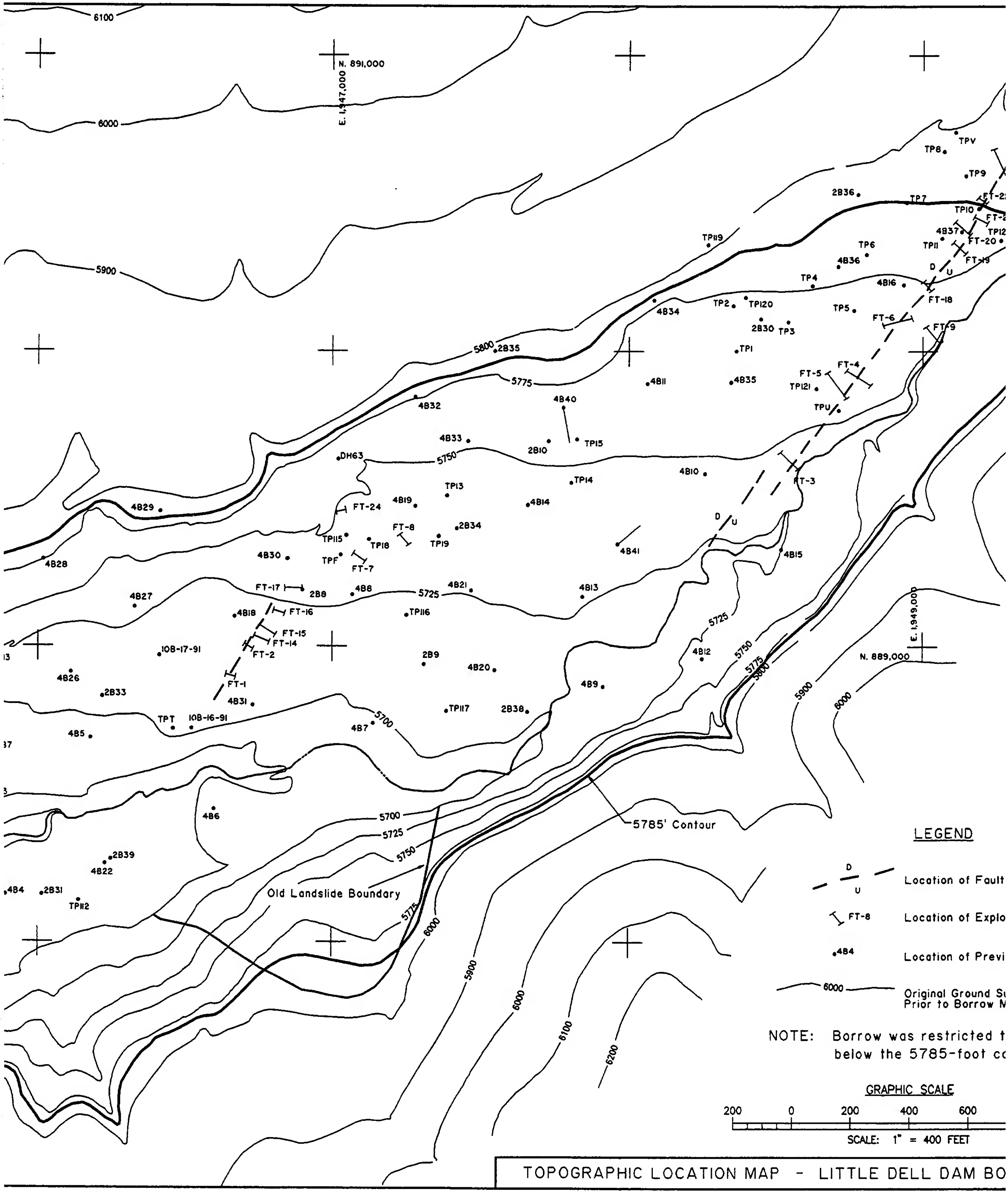
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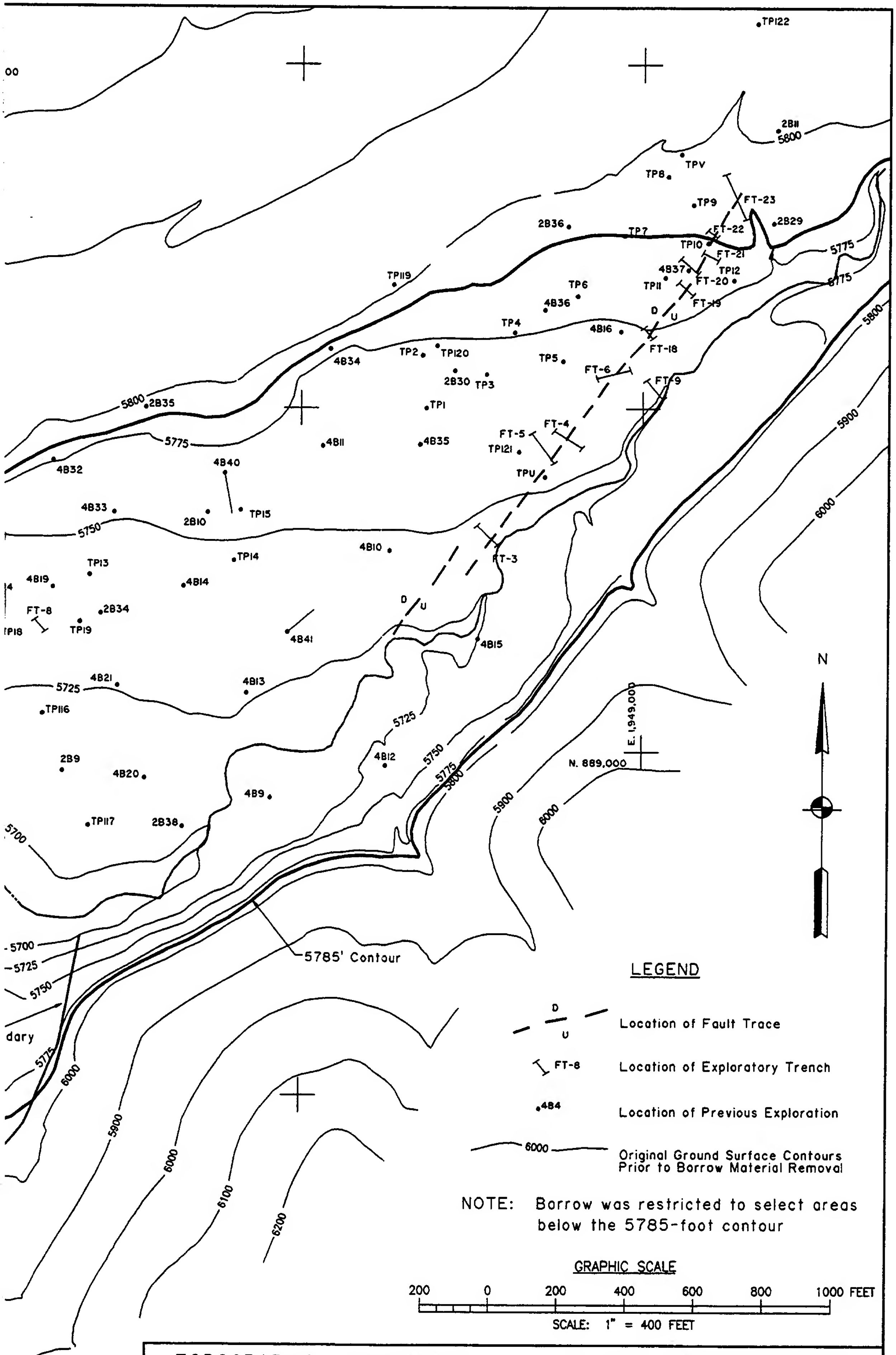
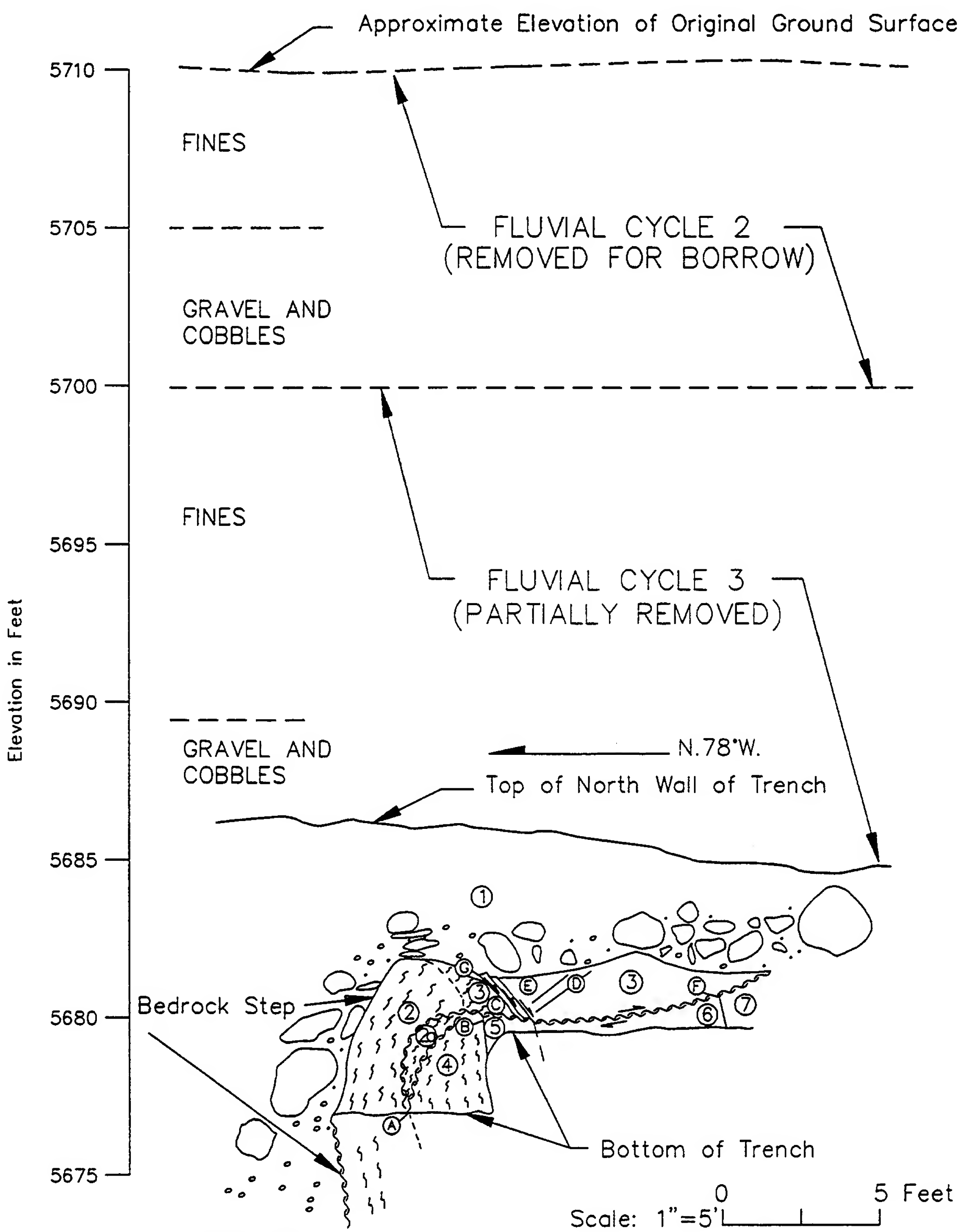


TOPOGRAPHIC LOCATION MAP - LITTLE DELL DAM BORROW AREA

FIGURE 2

Logged by: B.A. Bryant and C.E. Cole   Date: 6/22/92



NOTE: Location shown on Figure 2

DESCRIPTION

Alluvium

① Gravel and Cobbles, poorly sorted in a red-brown sand matrix

Frontier Formation

② Claystone (Sheared), light olive-gray with red-brown mottling, moist to dry, soft to moderately hard (when dry)

②a Same as 2 but very light olive-gray

③ Clayey Siltstone, olive green, intensely fractured with some shearing, well defined fracture set

④ Siltstone, light brown, abundant randomly oriented fractures, minor shearing

⑤ Silty Sandstone, very fine grained, light gray, well-cemented, hard

⑥ Silty Sandstone, black to red-brown, weak to moderate cementation

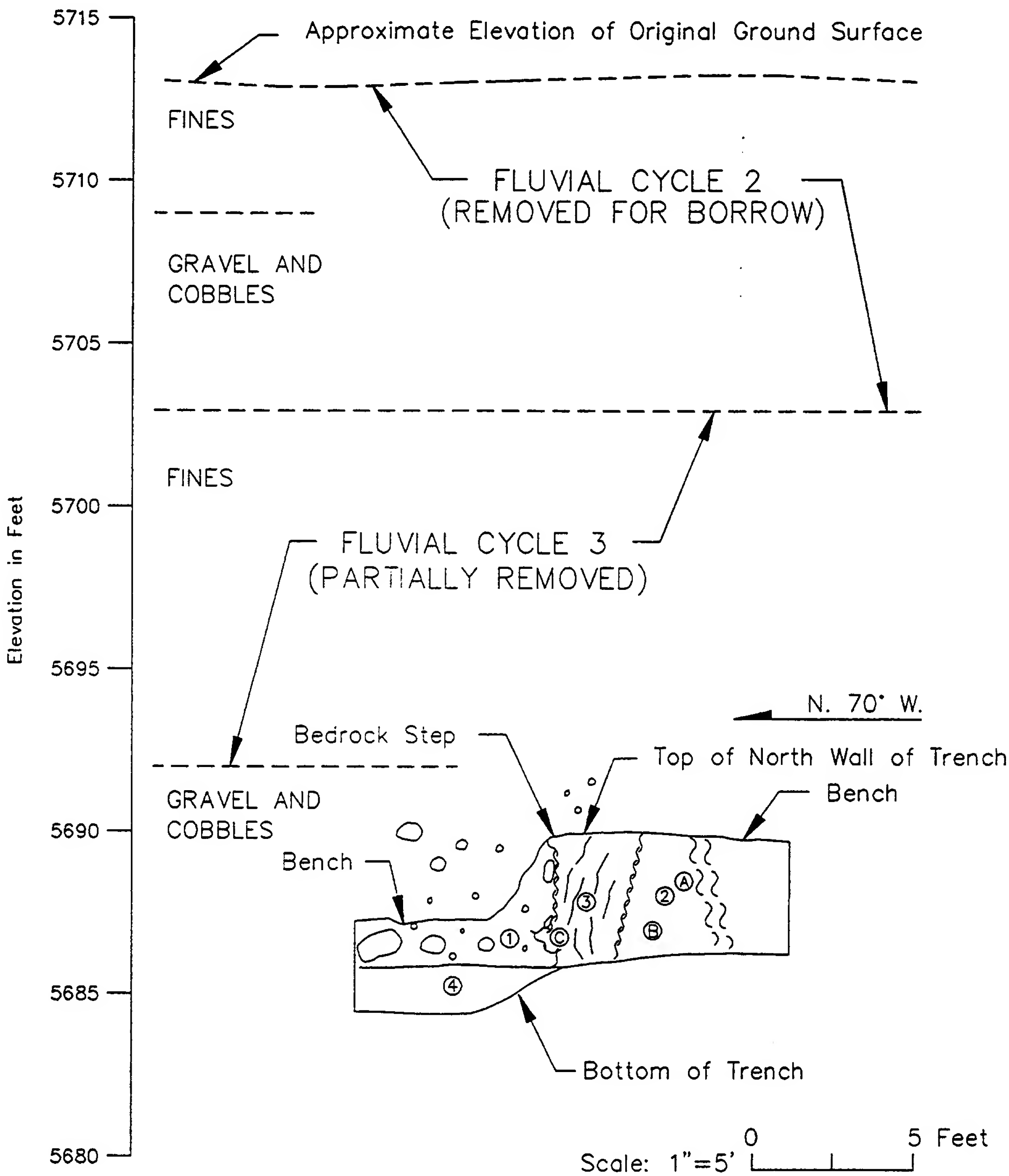
⑦ Clayey Siltstone, gray

ATTITUDES (360° Compass)

Ⓐ	20–40°, 60–70°E,	Fault
Ⓑ	25°, 73°E,	Bedding Contact
Ⓒ	85°, 47°N,	Fault
Ⓓ	90°, 78°N,	Fault
Ⓔ	78°, 82°N,	Fault
Ⓕ	90°, 57°N,	Fault
Ⓖ	357°, 44°E,	Shear

FT – 1

Figure 3



NOTE: Location shown on Figure 2

Logged by: B.A. Bryant Date: 9-30-92

DESCRIPTION

Alluvium

① Cobble conglomerate, rounded to subrounded cobbles, poorly sorted, scattered small boulders to 20" diameter; matrix is silty sand, light brown (5YR, 6/4), dense.

② Sandy siltstone (tuffaceous), white, medium hard, intensely fractured

③ Clay (fault gauge/altered tuff), olive green, very soft, sheared

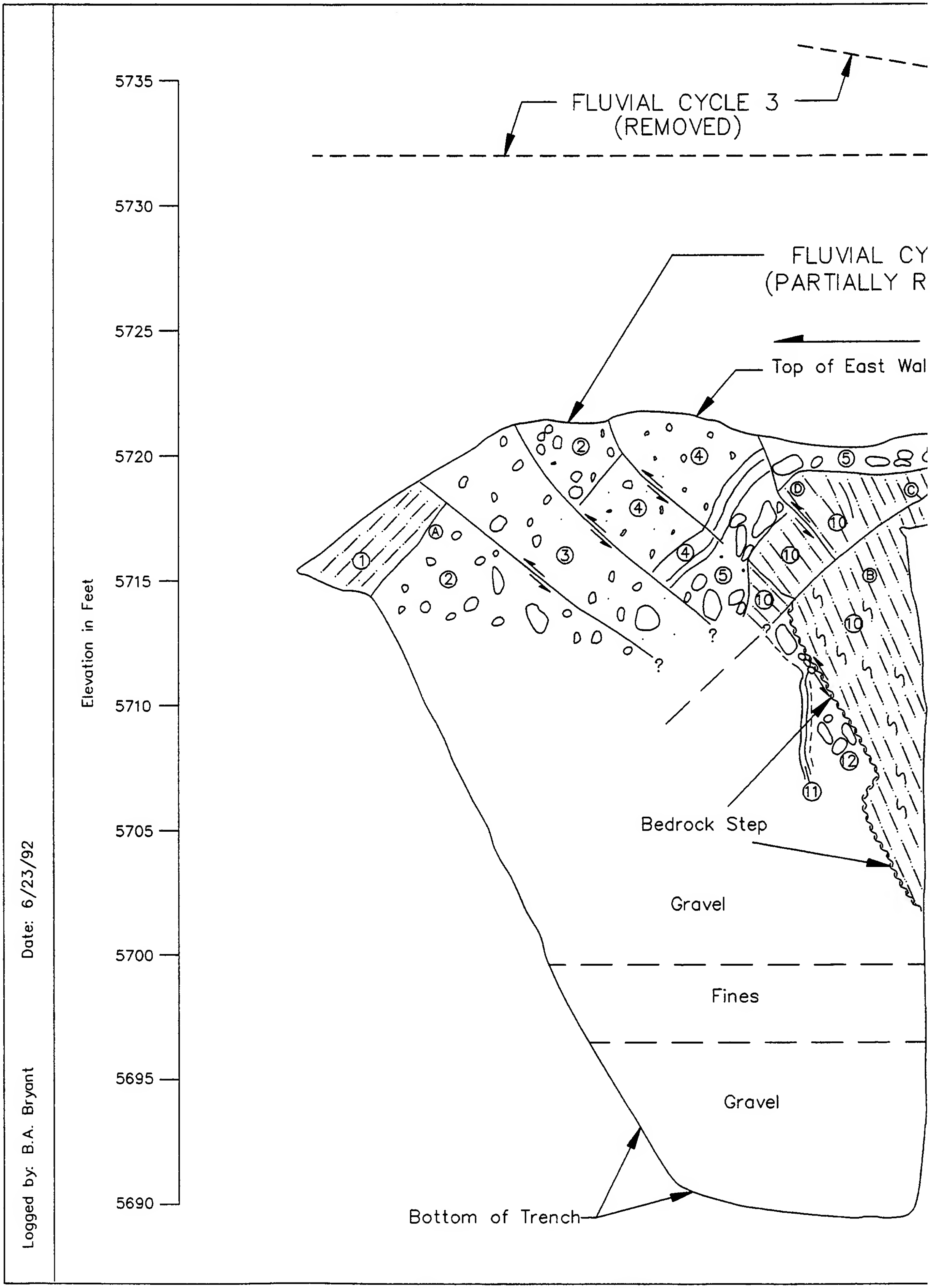
④ Siltstone, mottled medium brown and olive gray, medium soft to medium hard, highly fractured

ATTITUDES (360° Compass)

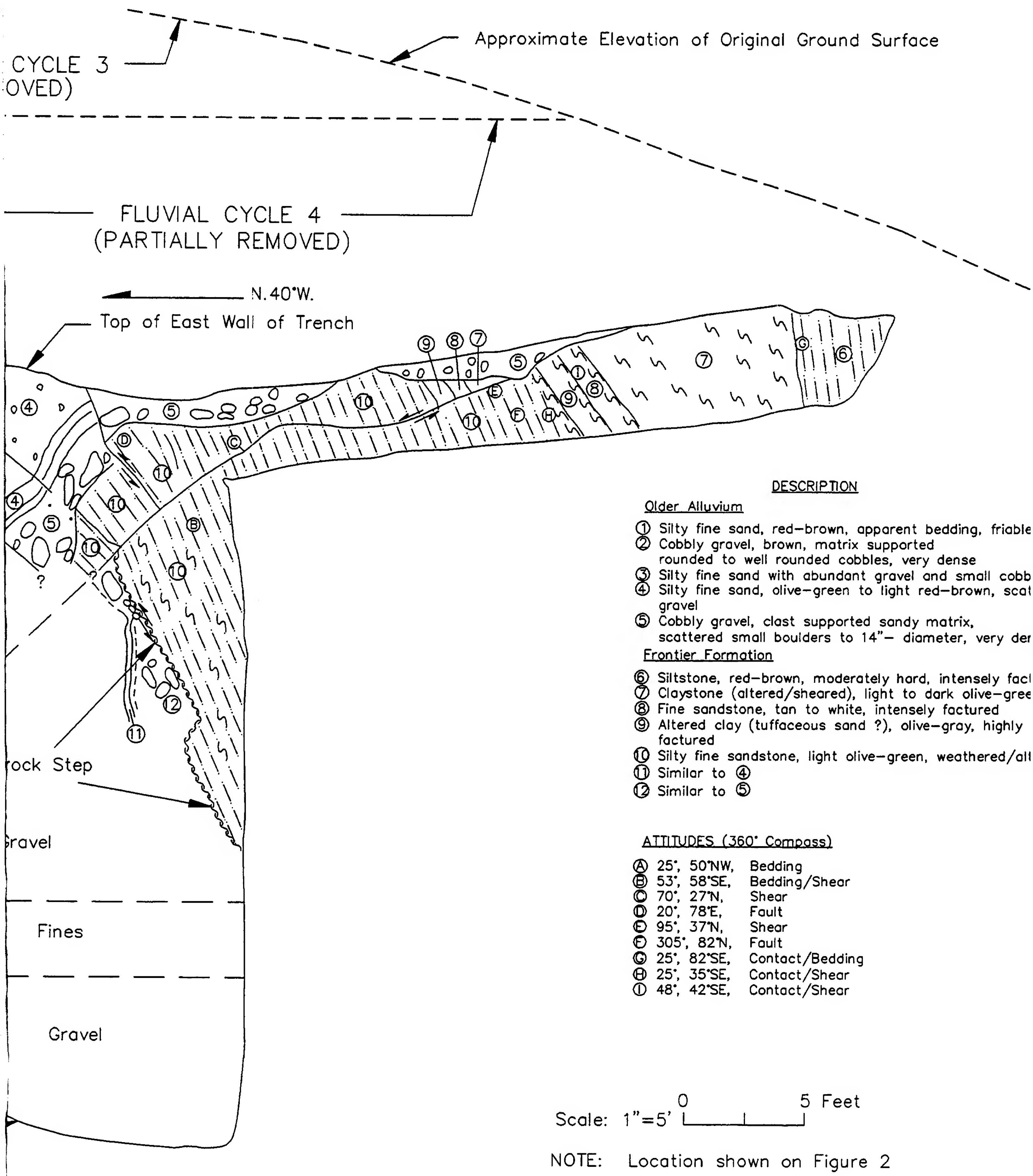
Ⓐ	20°, 62° E	Shear/Bedding
Ⓑ	35°, 52° E	Fracture
Ⓒ	34°, 80° E to 80° W	Fault/Shear

FT – 2

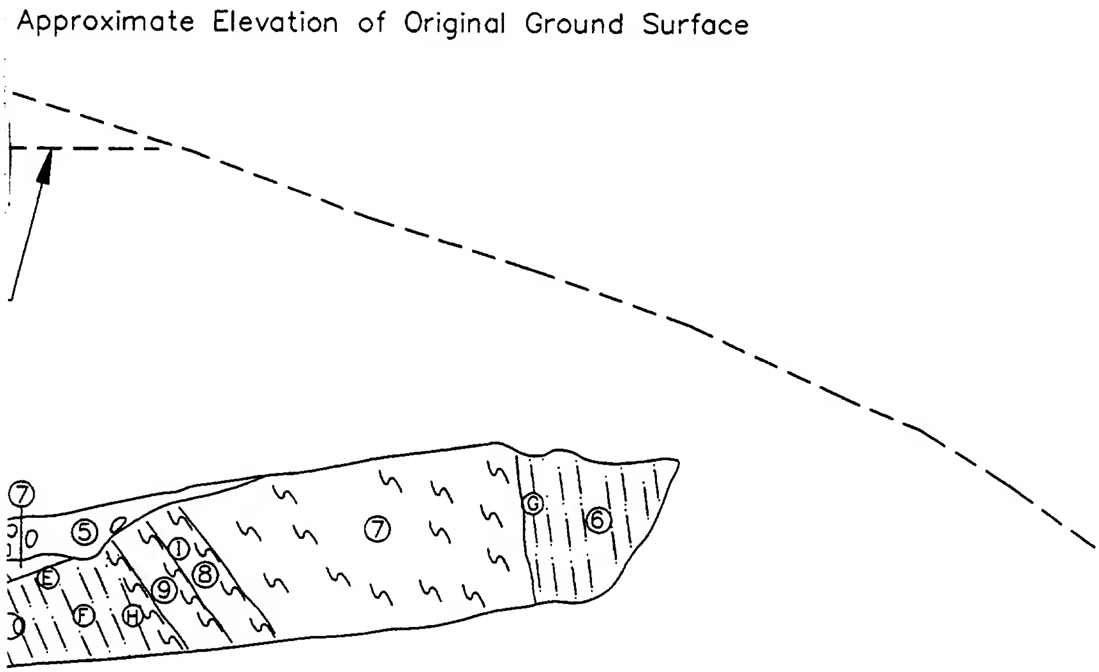
Figure 4



Logged by: B.A. Bryant
Date: 6/23/92
Elevation in Feet
5735
5730
5725
5720
5715
5710
5705
5700
5695
5690
FLUVIAL CYCLE 3
(REMOVED)
FLUVIAL CY
(PARTIALLY R
Top of East Wal
Bedrock Step
Gravel
Fines
Gravel
Bottom of Trench



Approximate Elevation of Original Ground Surface
CYCLE 3
OVED)
FLUVIAL CYCLE 4
(PARTIALLY REMOVED)
N.40°W.
Top of East Wall of Trench
rock Step
ravel
Fines
Gravel
DESCRIPTION
Older Alluvium
① Silty fine sand, red–brown, apparent bedding, friable
② Cobbly gravel, brown, matrix supported rounded to well rounded cobbles, very dense
③ Silty fine sand with abundant gravel and small cobb
④ Silty fine sand, olive–green to light red–brown, scat gravel
⑤ Cobbly gravel, clast supported sandy matrix, scattered small boulders to 14"– diameter, very der
Frontier Formation
⑥ Siltstone, red–brown, moderately hard, intensely fact
⑦ Claystone (altered/sheared), light to dark olive–gree
⑧ Fine sandstone, tan to white, intensely factured
⑨ Altered clay (tuffaceous sand ?), olive–gray, highly factured
⑩ Silty fine sandstone, light olive–green, weathered/alt
⑪ Similar to ④
⑫ Similar to ⑤
ATTITUDES (360° Compass)
Ⓐ 25°, 50°NW, Bedding
Ⓑ 53°, 58°SE, Bedding/Shear
Ⓒ 70°, 27°N, Shear
Ⓓ 20°, 78°E, Fault
Ⓔ 95°, 37°N, Shear
Ⓕ 305°, 82°N, Fault
Ⓖ 25°, 82°SE, Contact/Bedding
Ⓗ 25°, 35°SE, Contact/Shear
Ⓘ 48°, 42°SE, Contact/Shear
Scale: 1"=5' 0 5 Feet
NOTE: Location shown on Figure 2



DESCRIPTION

Older Alluvium

1 Silty fine sand, red–brown, apparent bedding, friable
2 Cobbly gravel, brown, matrix supported
rounded to well rounded cobbles, very dense
3 Silty fine sand with abundant gravel and small cobbles
4 Silty fine sand, olive–green to light red–brown, scattered gravel
5 Cobbly gravel, clast supported sandy matrix, scattered small boulders to 14"– diameter, very dense

Frontier Formation

6 Siltstone, red–brown, moderately hard, intensely factured
7 Claystone (altered/sheared), light to dark olive–green
8 Fine sandstone, tan to white, intensely factured
9 Altered clay (tuffaceous sand ?), olive–gray, highly to intensely factured
10 Silty fine sandstone, light olive–green, weathered/altered texture
11 Similar to 4
12 Similar to 5

ATTITUDES (360° Compass)

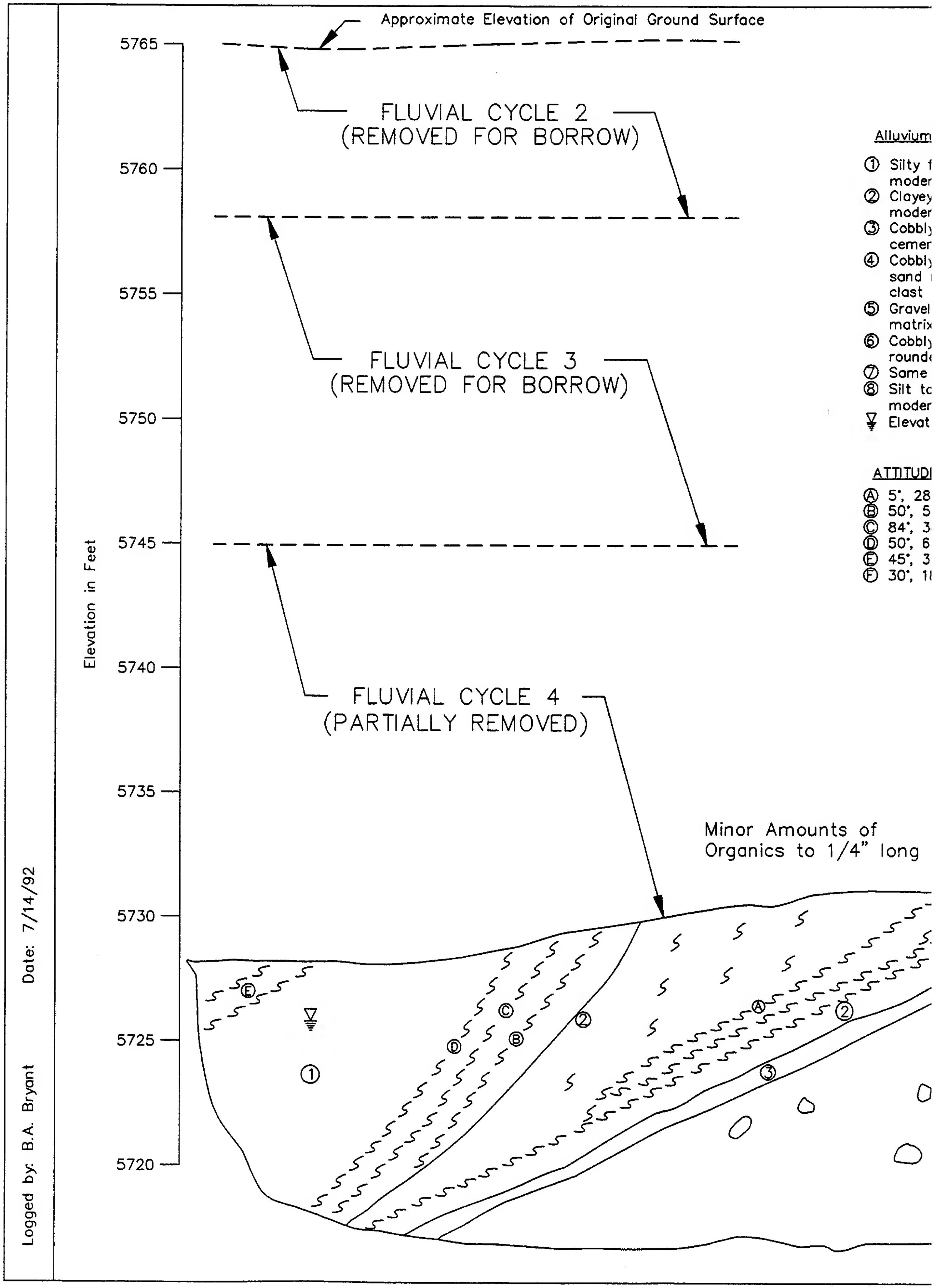
A	25°, 50°NW,	Bedding
B	53°, 58°SE,	Bedding/Shear
C	70°, 27°N,	Shear
D	20°, 78°E,	Fault
E	95°, 37°N,	Shear
F	305°, 82°N,	Fault
G	25°, 82°SE,	Contact/Bedding
H	25°, 35°SE,	Contact/Shear
I	48°, 42°SE,	Contact/Shear

Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 3

Figure 5



Approximate Elevation of Original Ground Surface
5765
5760
5755
5750
5745
5740
5735
5730
5725
5720
Elevation in Feet
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
FLUVIAL CYCLE 3
(REMOVED FOR BORROW)
FLUVIAL CYCLE 4
(PARTIALLY REMOVED)
Minor Amounts of
Organics to 1/4" long
Alluvium
ATTITUD
Logged by: B.A. Bryant
Date: 7/14/92

face

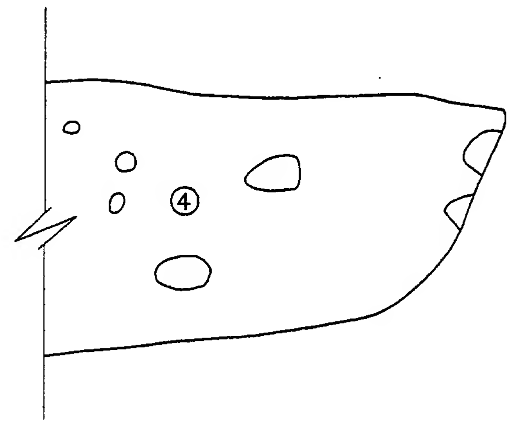
DESCRIPTION

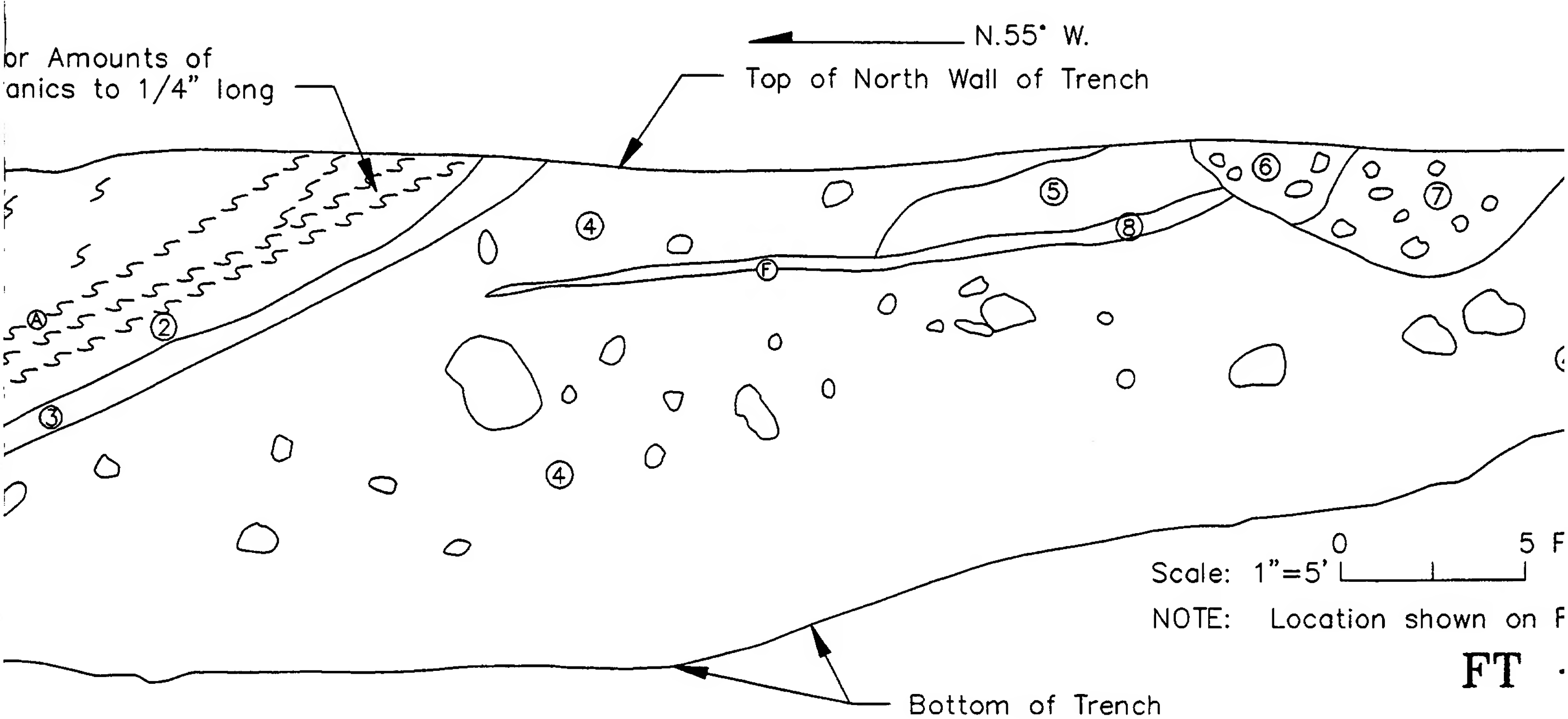
Alluvium

① Silty fine sand (weathered), red-brown, moderately soft to moderately hard, highly fractured massive
② Clayey silt, light olive-gray to dark gray moderately soft, moderately to highly fractured
③ Cobbly gravel, poorly sorted with gray clayey sand matrix (lacks cementation), rounded gravel and cobbles, matrix to clast supported
④ Cobbly gravel, poorly sorted, scattered small boulders with red-brown sand matrix, lacks cementation, rounded gravel and cobbles, predominantly clast supported
⑤ Gravel, moderate to well sorted with brownish-gray sand matrix
⑥ Cobbly gravel, poorly sorted, with gray-brown sandy matrix, clast supported, rounded cobbles
⑦ Same as ⑥ with rust colored sand matrix
⑧ Silt to fine sand, red-brown, brown, and light gray, moderately soft, moderately fractured
▽ Elevation of groundwater on 7/14/92

ATTITUDES (360° Compass)

Ⓐ	5°, 28–70°N,	Bedding/Shear
Ⓑ	50°, 58°N,	Shear
Ⓒ	84°, 38°N,	Shear
Ⓓ	50°, 62°N,	Shear
Ⓔ	45°, 32°N,	Shear/Fault
Ⓕ	30°, 18°NW,	Bedding





Scale: 1"=5' 0 5 F

NOTE: Location shown on F

FT

Figure

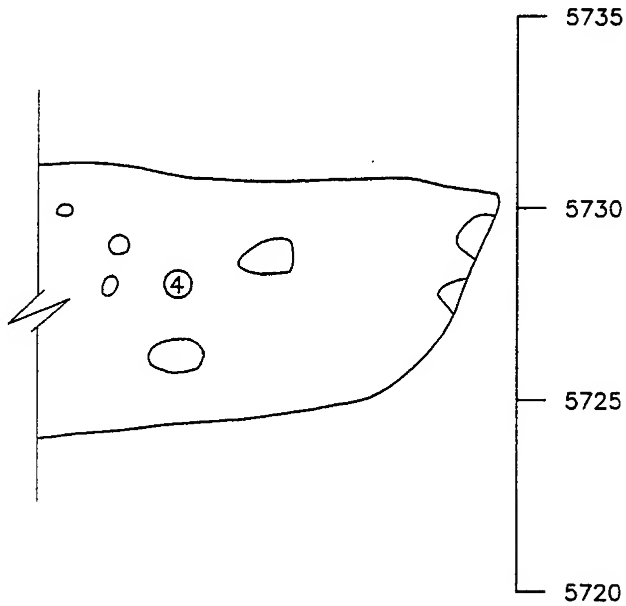
moderately soft to
'e
moderately soft,

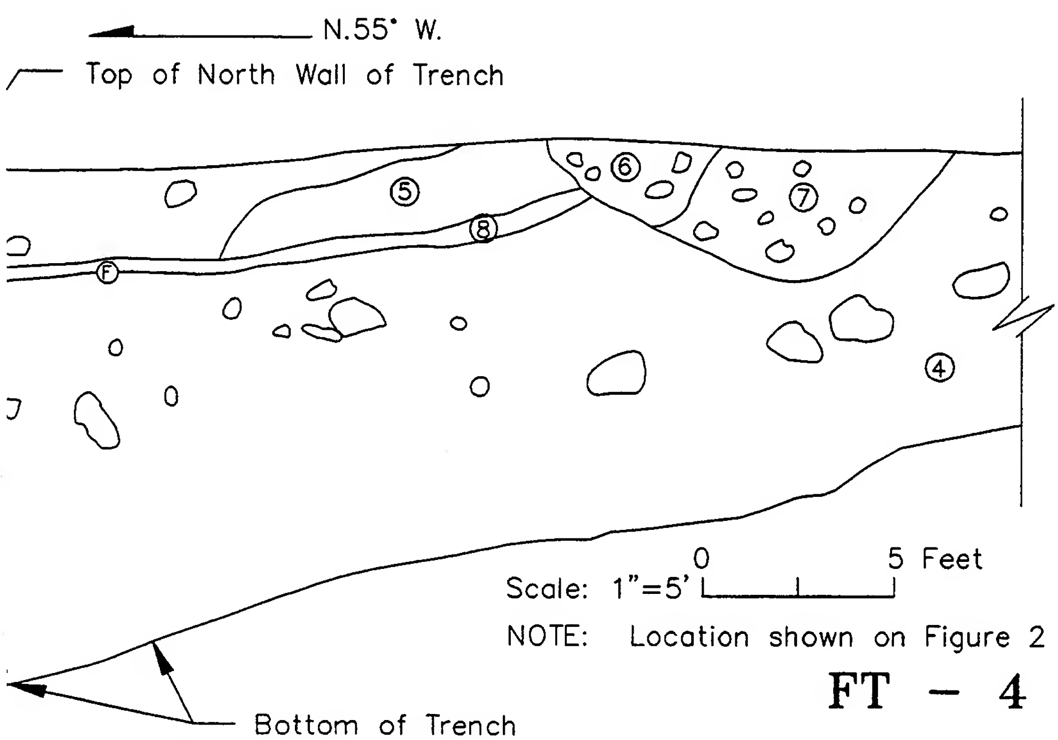
ayey sand matrix (lacks
's, matrix to clast supported
mall boulders with red–brown
gravel and cobbles, predominantly

wnish–gray sand

rown sandy matrix, clast supported,

itrix
light gray, moderately soft,



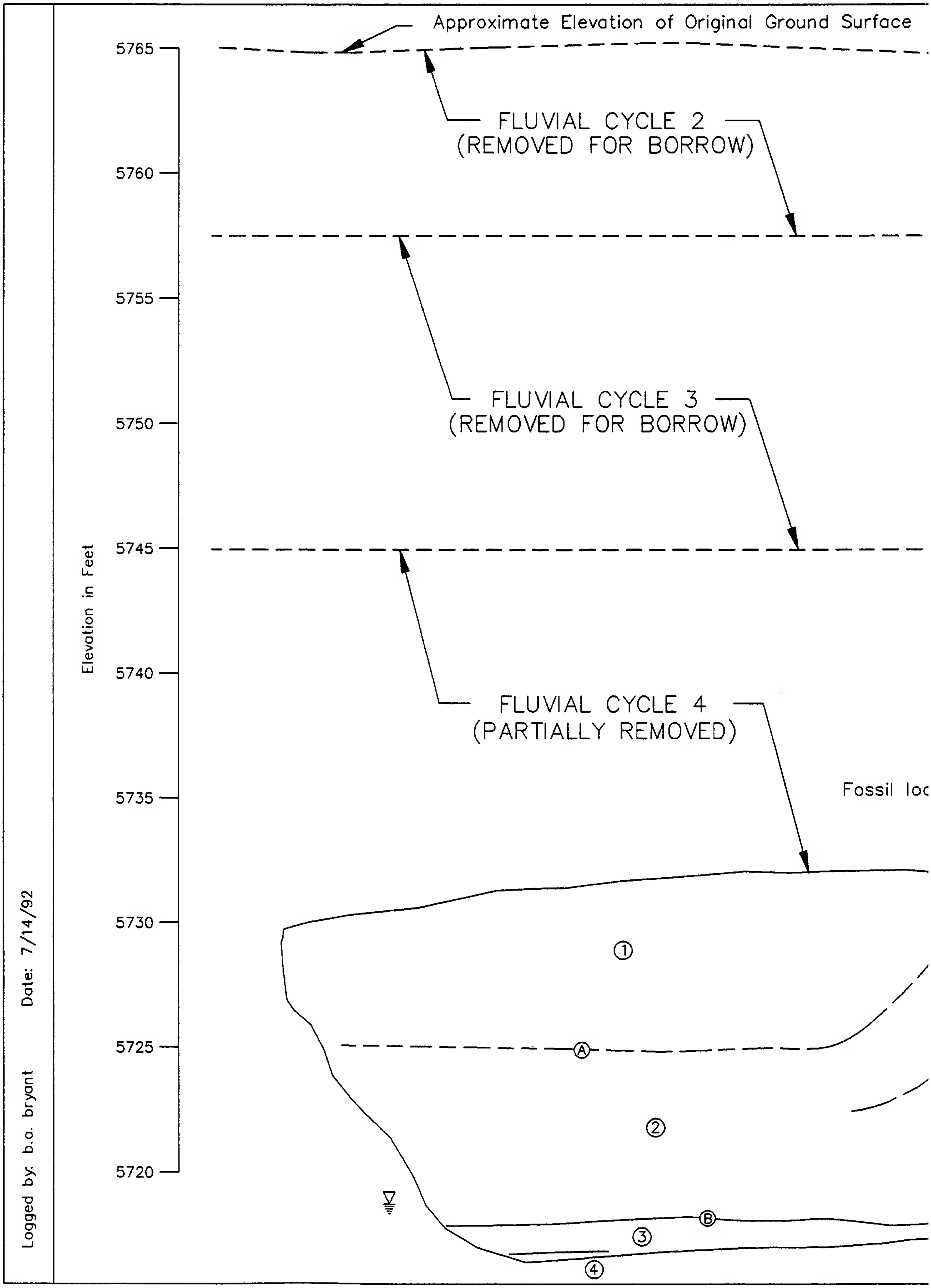


Scale: 1"=5' 0 5 Feet

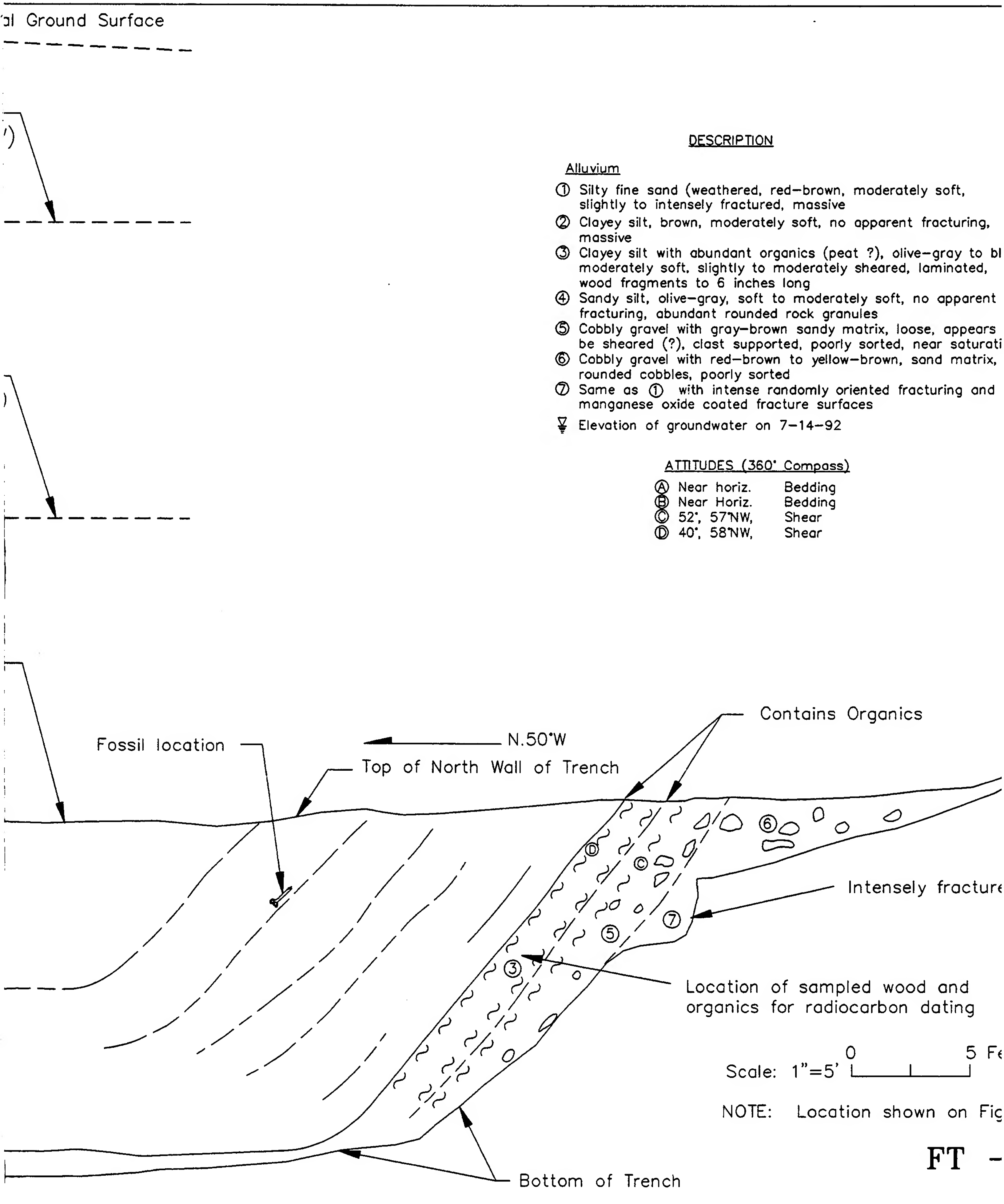
NOTE: Location shown on Figure 2

FT – 4

Figure 6



Approximate Elevation of Original Ground Surface
5765
5760
5755
5750
5745
5740
5735
5730
5725
5720
Elevation in Feet
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
FLUVIAL CYCLE 3
(REMOVED FOR BORROW)
FLUVIAL CYCLE 4
(PARTIALLY REMOVED)
Fossil loc
1
A
2
B
3
4
Logged by: b.a. bryant
Date: 7/14/92



al Ground Surface
')
)
DESCRIPTION
Alluvium
① Silty fine sand (weathered, red-brown, moderately soft, slightly to intensely fractured, massive
② Clayey silt, brown, moderately soft, no apparent fracturing, massive
③ Clayey silt with abundant organics (peat ?), olive-gray to bl moderately soft, slightly to moderately sheared, laminated, wood fragments to 6 inches long
④ Sandy silt, olive-gray, soft to moderately soft, no apparent fracturing, abundant rounded rock granules
⑤ Cobbly gravel with gray-brown sandy matrix, loose, appears be sheared (?), clast supported, poorly sorted, near saturati
⑥ Cobbly gravel with red-brown to yellow-brown, sand matrix, rounded cobbles, poorly sorted
⑦ Same as ① with intense randomly oriented fracturing and manganese oxide coated fracture surfaces
Elevation of groundwater on 7-14-92
ATTITUDES (360° Compass)
Ⓐ Near horiz. Bedding
Ⓑ Near Horiz. Bedding
Ⓒ 52°, 57°NW, Shear
Ⓓ 40°, 58°NW, Shear
Contains Organics
Fossil location
N.50°W
Top of North Wall of Trench
Ⓓ
⑥
Ⓒ
Intensely fracture
⑦
⑤
③
Location of sampled wood and organics for radiocarbon dating
Scale: 1"=5'
0
5 Fe
NOTE: Location shown on Fig
Bottom of Trench
FT -

Figure

DESCRIPTION

Alluvium

① Silty fine sand (weathered, red–brown, moderately soft, slightly to intensely fractured, massive

② Clayey silt, brown, moderately soft, no apparent fracturing, massive

③ Clayey silt with abundant organics (peat ?), olive–gray to black, moderately soft, slightly to moderately sheared, laminated, wood fragments to 6 inches long

④ Sandy silt, olive–gray, soft to moderately soft, no apparent fracturing, abundant rounded rock granules

⑤ Cobbly gravel with gray–brown sandy matrix, loose, appears to be sheared (?), clast supported, poorly sorted, near saturation

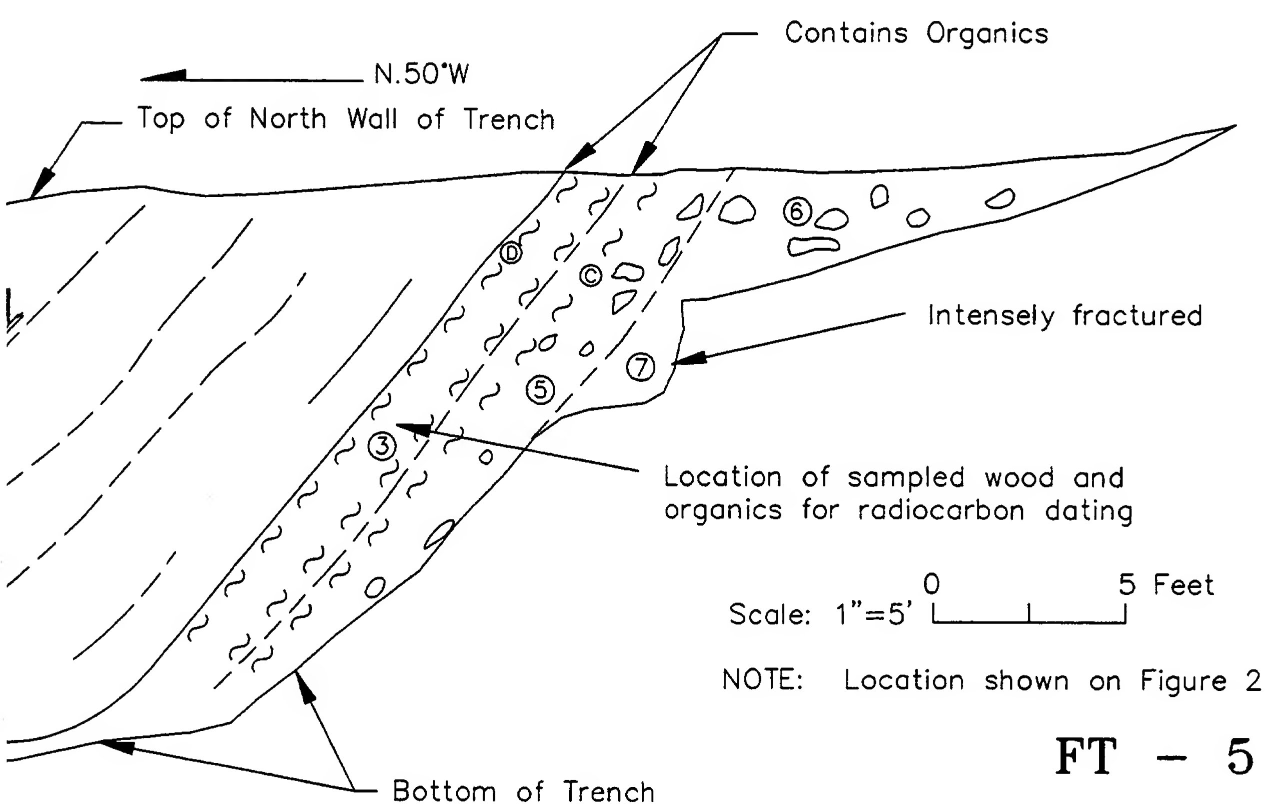
⑥ Cobbly gravel with red–brown to yellow–brown, sand matrix, rounded cobbles, poorly sorted

⑦ Same as ① with intense randomly oriented fracturing and manganese oxide coated fracture surfaces

∇ Elevation of groundwater on 7–14–92

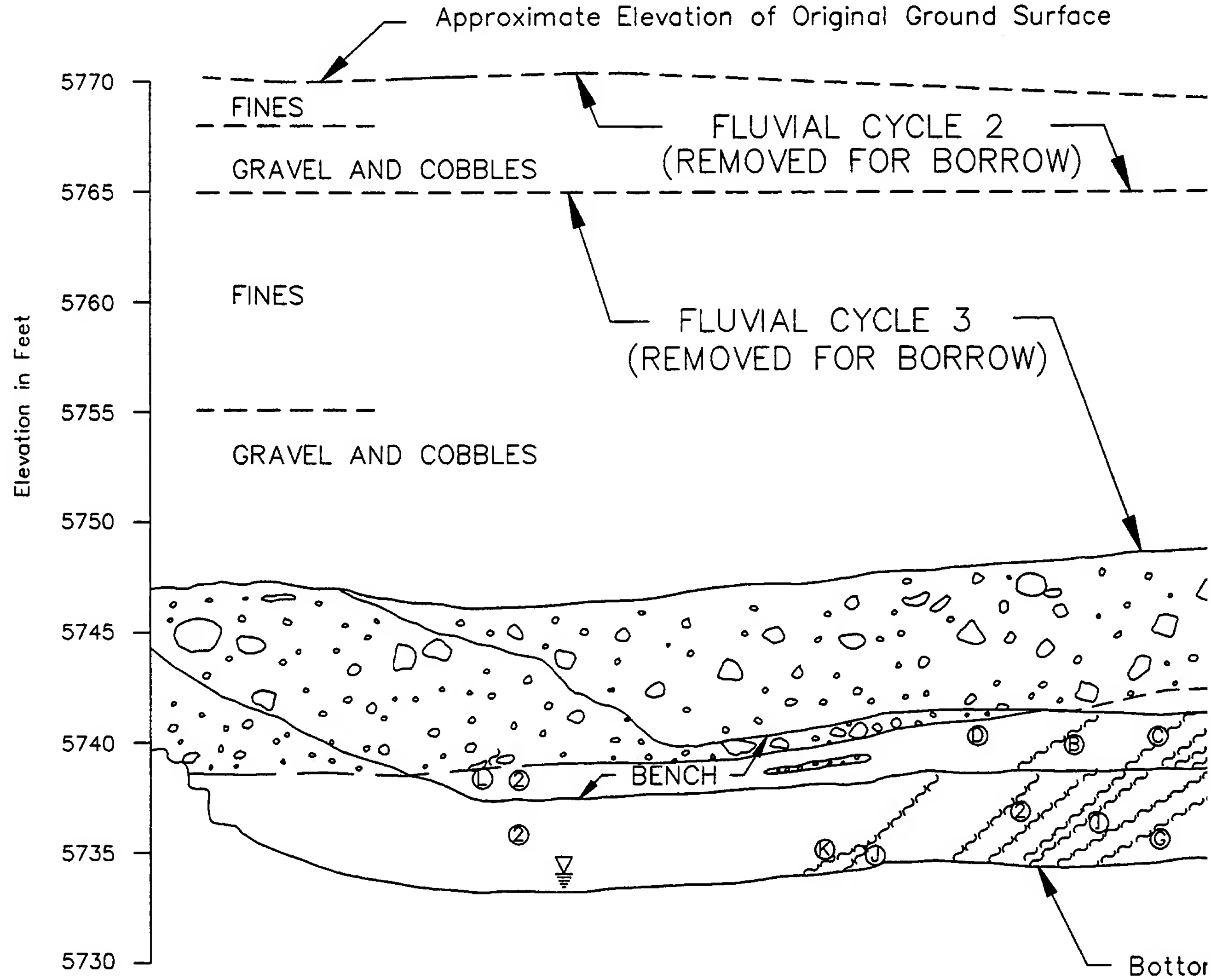
ATTITUDES (360° Compass)

Ⓐ	Near horiz.	Bedding
Ⓑ	Near Horiz.	Bedding
Ⓒ	52°, 57°NW,	Shear
Ⓓ	40°, 58°NW,	Shear

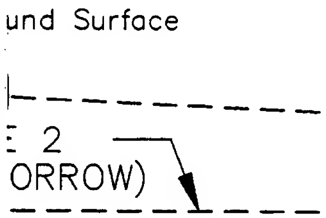


FT – 5

Figure 7



Logged by: B.A. Bryant Date: 7-30-92



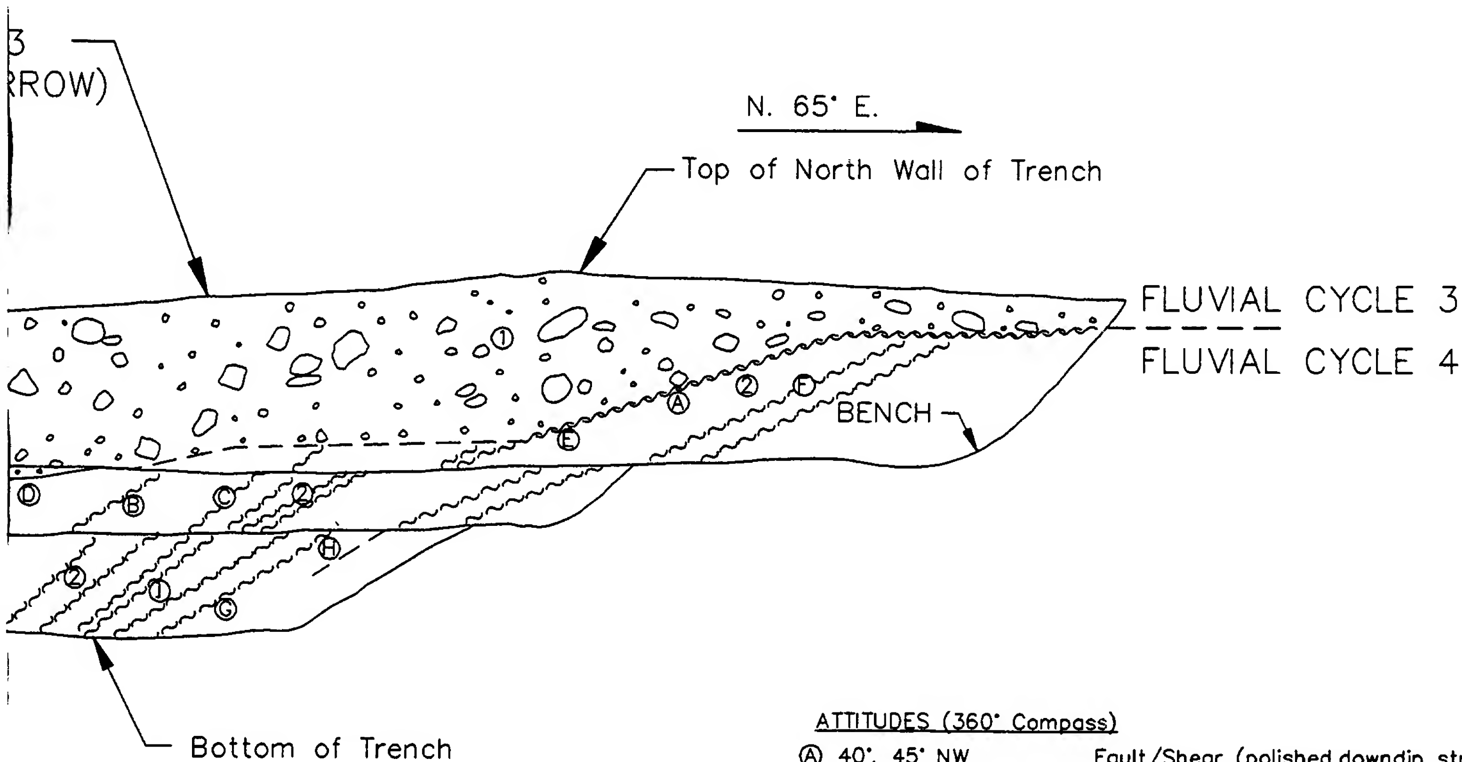
DESCRIPTION

Alluvium

① Cobbly gravel, poorly sorted, scattered boulders to 25"–diameter, rounded to well–rounded, clast to matrix supported, matrix is silty sand, brown to red–brown, damp to wet

② Sandy silt, brown to red–brown with scattered gray mottling damp to very wet, moderately soft, scattered gravel and small cobb (rounded), some apparent bedding, scattered gravel and sand lenses, becomes more clayey with depth

▽ Elevation of groundwater on 7–30–92



ATTITUDES (360° Compass)

Ⓐ	40°, 45° NW	Fault/Shear (polished,downdip striae)
Ⓑ	40°, 65° NW	Fault/Bedding (polished,downdip striae)
Ⓒ	34°, 65° NW	Fault/Shear (weathered surface)
Ⓓ	38°, 27° NW	Bedding
Ⓔ	45°, 43° NW	Fault/Shear (polished surface with striae)
Ⓕ	25°, 40° NW	Fault/Shear (weathered clay lined)
Ⓖ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓗ	40°, 53° NW	Beddding (sand lense)
Ⓘ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓙ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓚ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓛ	40°, 53° NW	Fault/Shear (polished with downdip striae)

Scale: 1"=8' 0 8 Feet

NOTE: Location shown on Figure 2

FT –

Figure

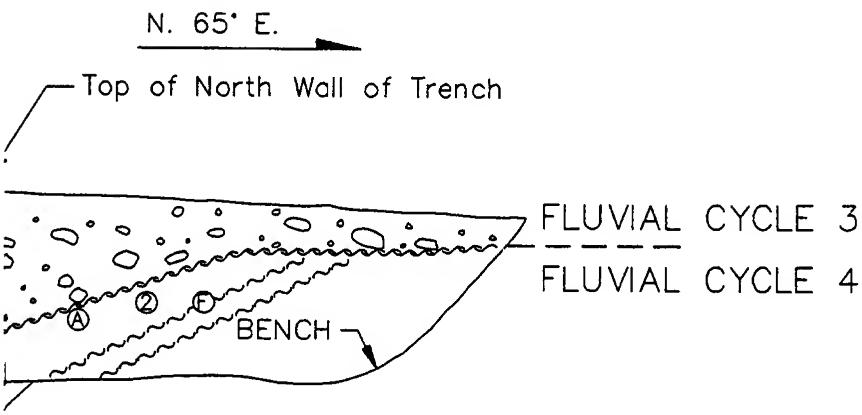
DESCRIPTION

Alluvium

① Cobbly gravel, poorly sorted, scattered boulders to 25"–diameter, rounded to well–rounded, clast to matrix supported, matrix is silty sand, brown to red–brown, damp to wet

② Sandy silt, brown to red–brown with scattered gray mottling damp to very wet, moderately soft, scattered gravel and small cobbles (rounded), some apparent bedding, scattered gravel and sand lenses, becomes more clayey with depth

∇ Elevation of groundwater on 7–30–92



ATTITUDES (360° Compass)

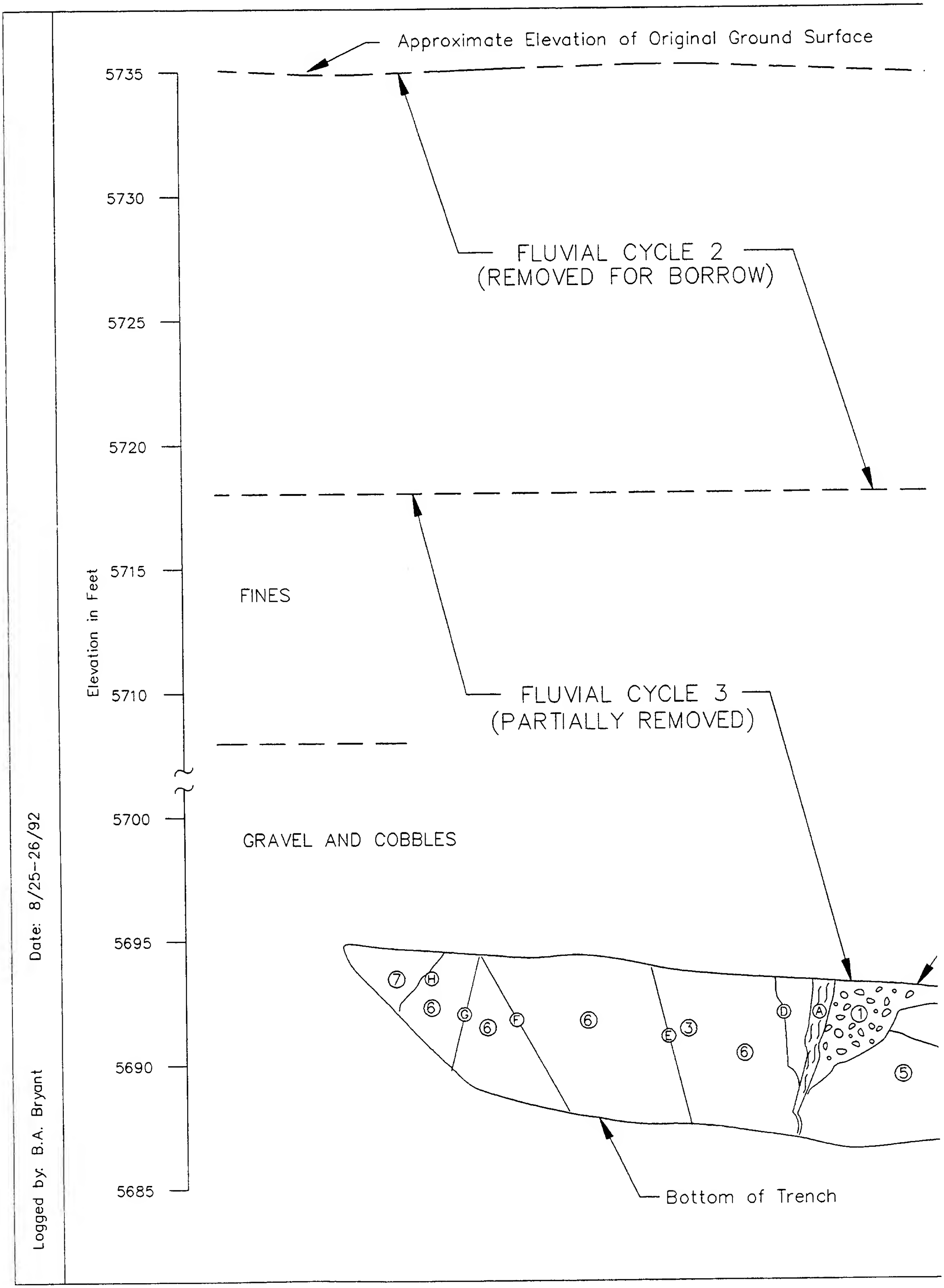
Ⓐ	40°, 45° NW	Fault/Shear (polished,downdip striae)
Ⓑ	40°, 65° NW	Fault/Bedding (polished,downdip striae)
Ⓒ	34°, 65° NW	Fault/Shear (weathered surface)
Ⓓ	38°, 27° NW	Bedding
Ⓔ	45°, 43° NW	Fault/Shear (polished surface with striae)
Ⓕ	25°, 40° NW	Fault/Shear (weathered clay lined)
Ⓖ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓗ	40°, 53° NW	Beddding (sand lense)
Ⓘ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓙ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓚ	40°, 53° NW	Fault/Shear (polished with downdip striae)
Ⓛ	40°, 53° NW	Fault/Shear (polished with downdip striae)

=8' 0 8 Feet

cation shown on Figure 2

FT – 6

Figure 8



Approximate Elevation of Original Ground Surface
5735
5730
5725
5720
5715
5710
5700
5695
5690
5685
Elevation in Feet
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
FINES
FLUVIAL CYCLE 3
(PARTIALLY REMOVED)
GRAVEL AND COBBLES
7 H 6 G 6 F 6 E 3 6 D A 1 5
Bottom of Trench
Logged by: B.A. Bryant
Date: 8/25-26/92

DESCRIPTION

Alluvium

① Cobbly Gravel, clast to matrix supported, round clasts, generally an irregular contact with underlying material, coarsens upstream; matrix is clayey to fine gravel sand, red–brown, soft to very soft,very wet to saturated adjacent to fault

Frontier Formation

② Sandstone, light gray (5YR, 8/1) moderately hard, medium fractured (salt and pepper appearance), fine gravel

③ Sandstone, pale olive (10YR, 6/2) with pale yellowish orange (10YR, 8/6) mottling, very fine gravel, moderately soft to medium hard, medium to highly fractured, scattered randomly oriented discontinuous shears, 90% quartz grains

④ Sandstone, light gray (5YR, 8/1) moderately hard, medium fractured (salt and pepper appearance), fine grained

⑤ Sandy Siltstone, dark yellowish orange (10YR, 6/6), soft to moderately hard, intensely fractured, appears to be sheared with abundant randomly oriented, discontinuous polished surfaces

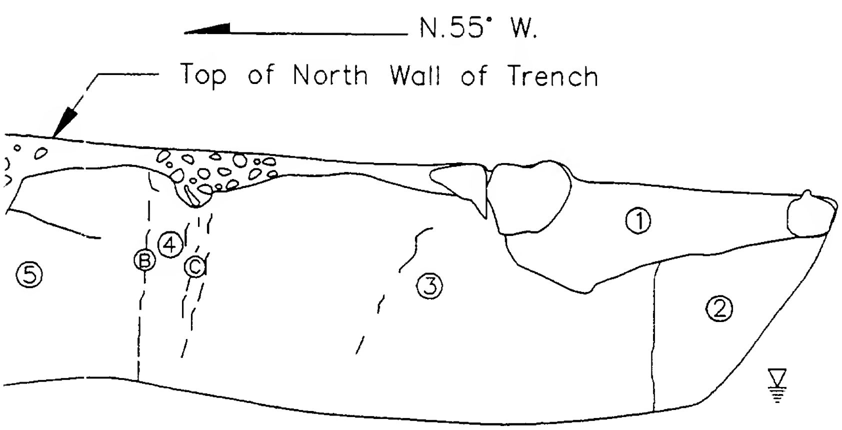
⑥ Siltstone, dark reddish brown (10YR, 3/4) to pale olive (10YR, 6/2) predominantly mottled appearance

⑦ Slightly Sandy Claystone, pale olive (10YR, 6/2) with pale yellowish orange (10YR, 8/6) mottled, soft, intensely factured

⊻ Elevation of groundwater on 8/26/92

ATTITUDES (360° Compass)

Ⓐ	27°, 70–82°W,	Fault
Ⓑ	30°, 75°W,	Bedding Contact/Shear
Ⓒ	22°, 68°W,	Bedding Contact
Ⓓ	54°, 71°E,	Fault
Ⓔ	69°, 84°S,	Shear
Ⓕ	358°, 76°E,	Fault
Ⓖ	30°, 76°W,	Fault
Ⓗ	66°, 68°N,	Shear/Fault



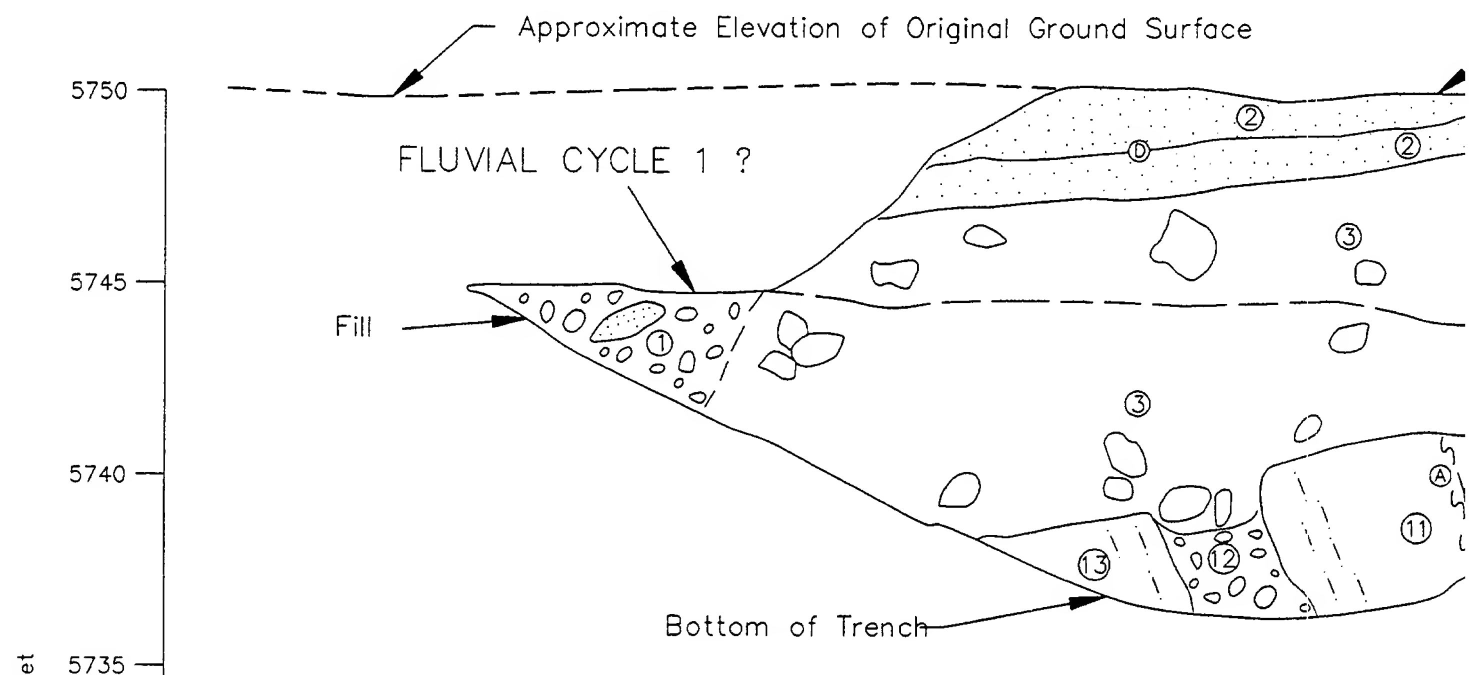
Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 7

Figure 9

FT-8 NOT LOGGED



DESCRIPTION

Fill

① Cobbly sand, brown to red-brown, loose

Alluvium

② Silty sand, red-brown to yellow-brown, moderately friable, fine grained, lacks cementation, dense; with thin beds of gray silt, very soft

③ Cobble conglomerate, predominantly clast supported, rounded clasts, scattered boulders to 2-foot diameter, abundant quartzite clasts; matrix is clayey sand to silty sand, red-brown, moderately friable, dense

Frontier Formation

④ Silty fine sandstone, orange-brown, moderately soft, moderately fractured

⑤ Silty fine sandstone, light red-brown, moderately soft to moderately hard, intensely fractured

⑥ Same as ④

⑦ Sandstone, gray, very hard, moderately fractured

⑧ Same as ④

⑨ Siltstone, light gray, soft to medium soft, intensely fractured

⑩ Same as ④

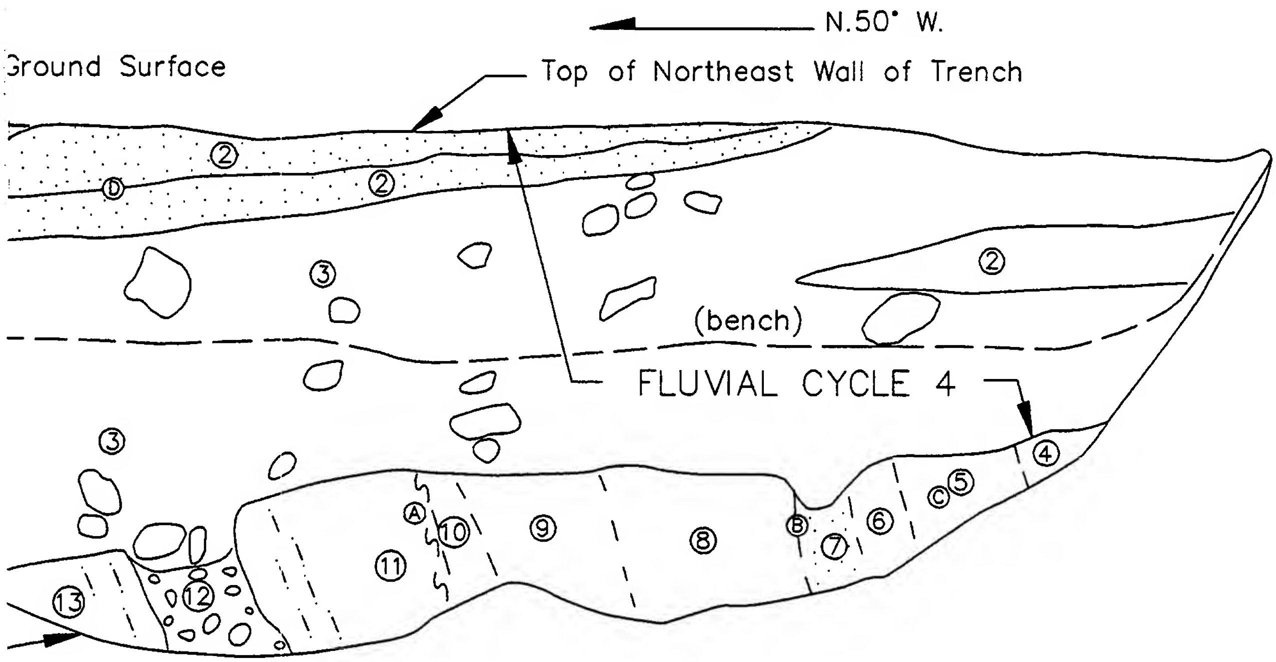
⑪ Same as ⑨

⑫ Conglomerate, clast supported, rounded gravel, scattered cobbles; matrix is silty sandstone, yellow-brown, loose to hard (brecciated)

⑬ Same as ⑨

Date: 8/29/92

Logged by: B.A. Bryant



ATTITUDES (360° Compass)

A	40°, 78°NW,	Shear
B	32°, 52°SE,	Bedding
C	268°, 46°N,	Joint
D	32°, 10°NW,	Bedding

oderately friable, fine grained,
of gray silt, very soft
supported, rounded clasts, scattered
uartzite clasts; matrix is
derately friable, dense

rately soft, moderately fractured
derately soft to moderately hard,

actured

. intensely fractured

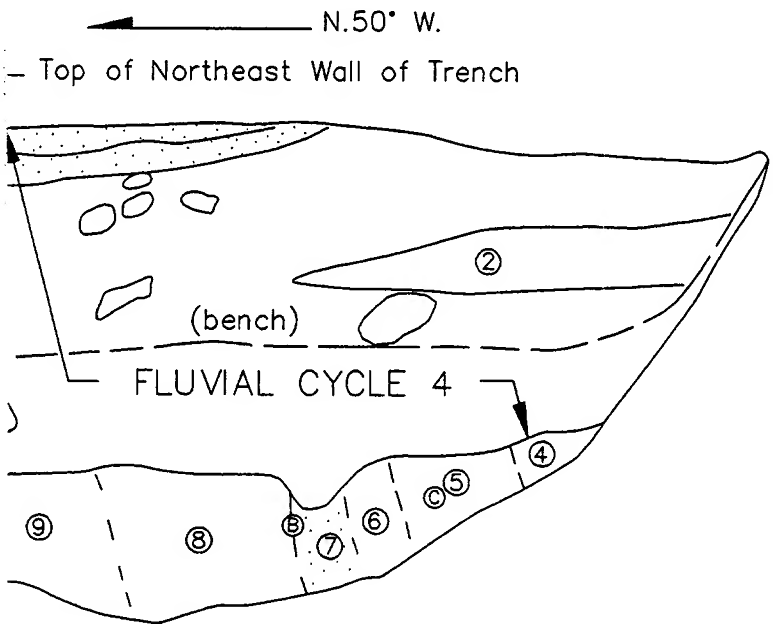
ravel, scattered cobbles;
ose to hard (brecciated)

Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT –

Figure



ATTITUDES (360° Compass)

Ⓐ 40°, 78°NW, Shear
Ⓑ 32°, 52°SE, Bedding
Ⓒ 268°, 46°N, Joint
Ⓓ 32°, 10°NW, Bedding

Scale: 1"=5' 0 5 Feet

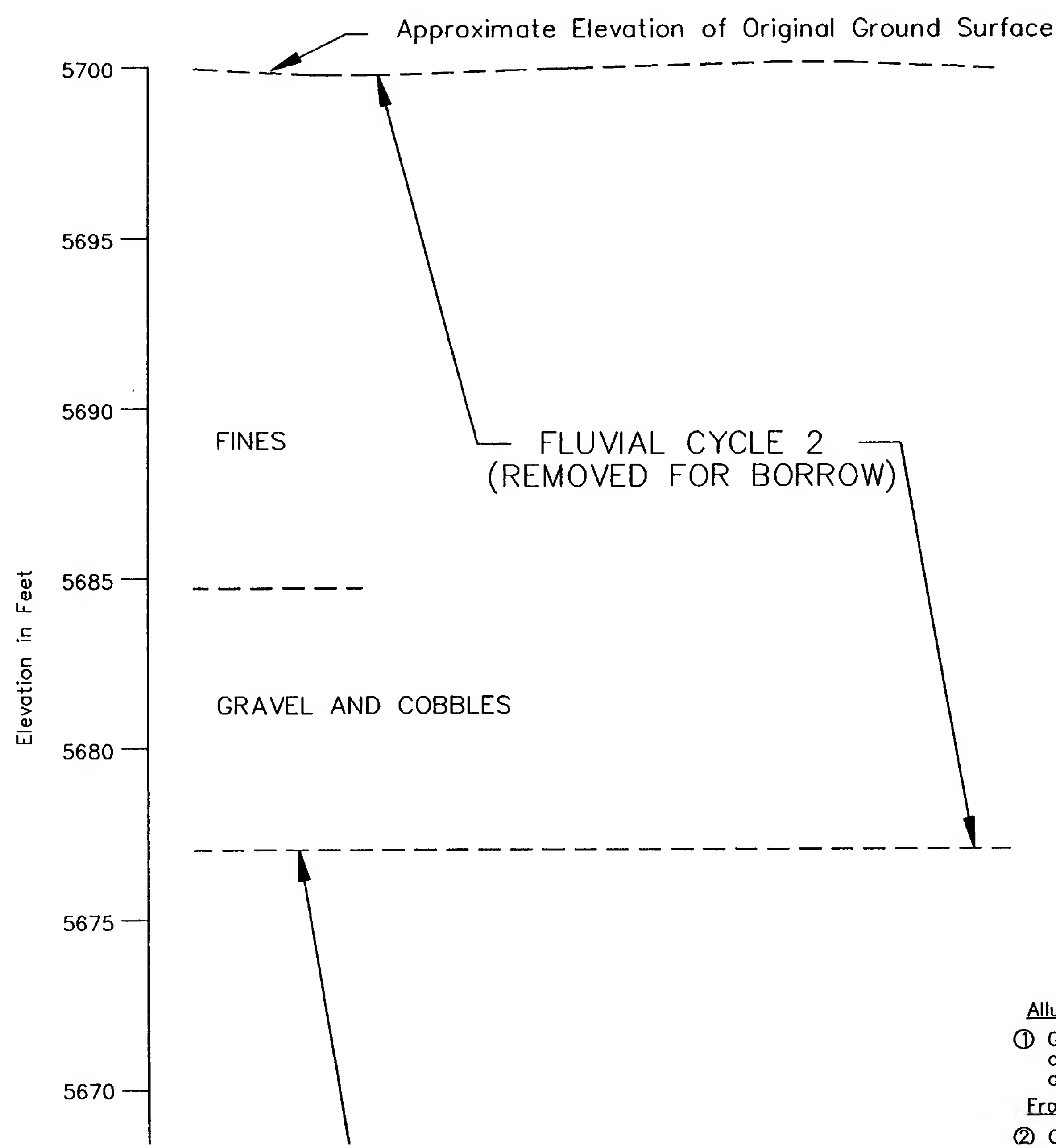
NOTE: Location shown on Figure 2

FT – 9

Figure 10

Logged by: B.A. Bryant

Date: 9/13/92



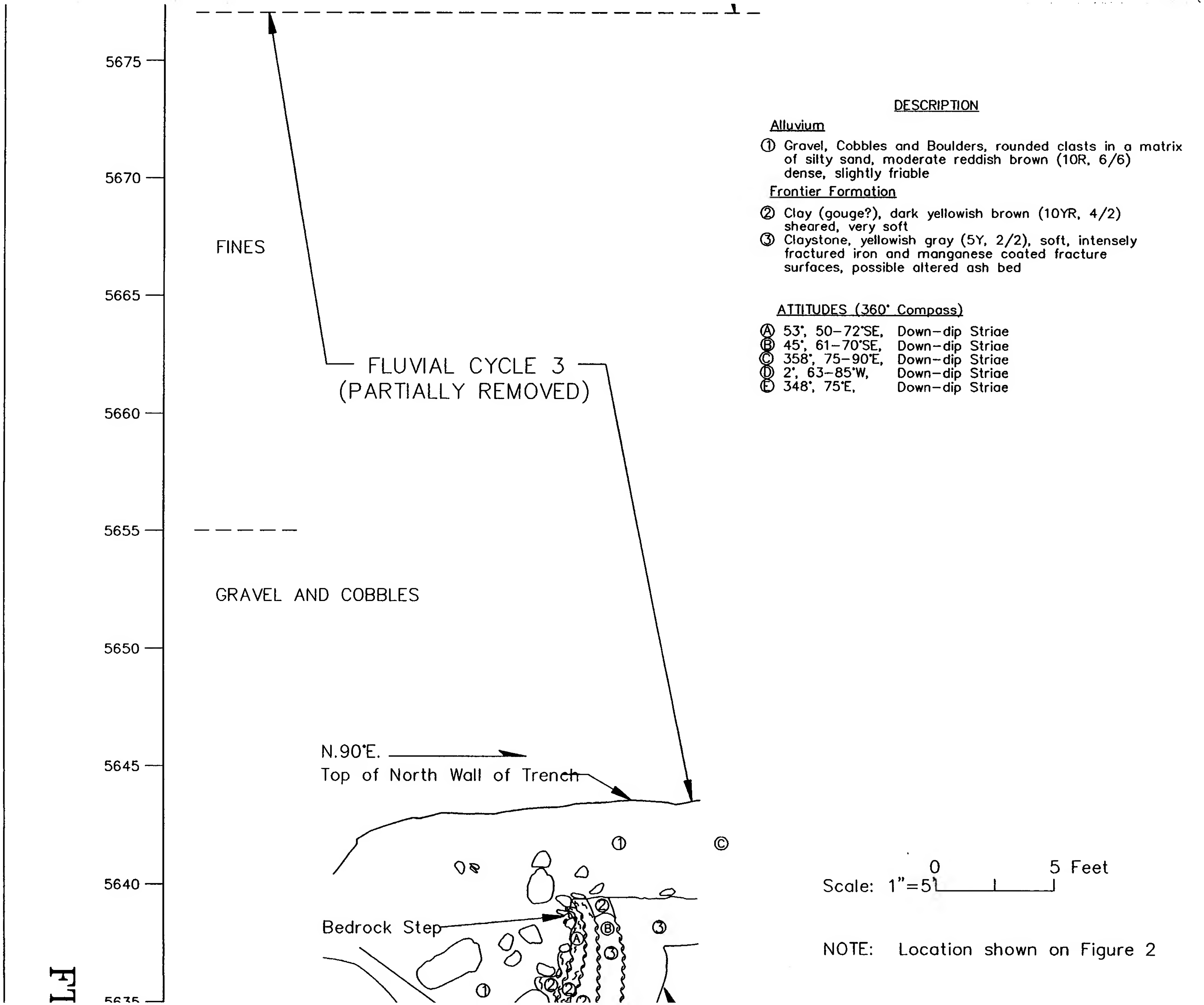
DESCRIPTION

Alluvium

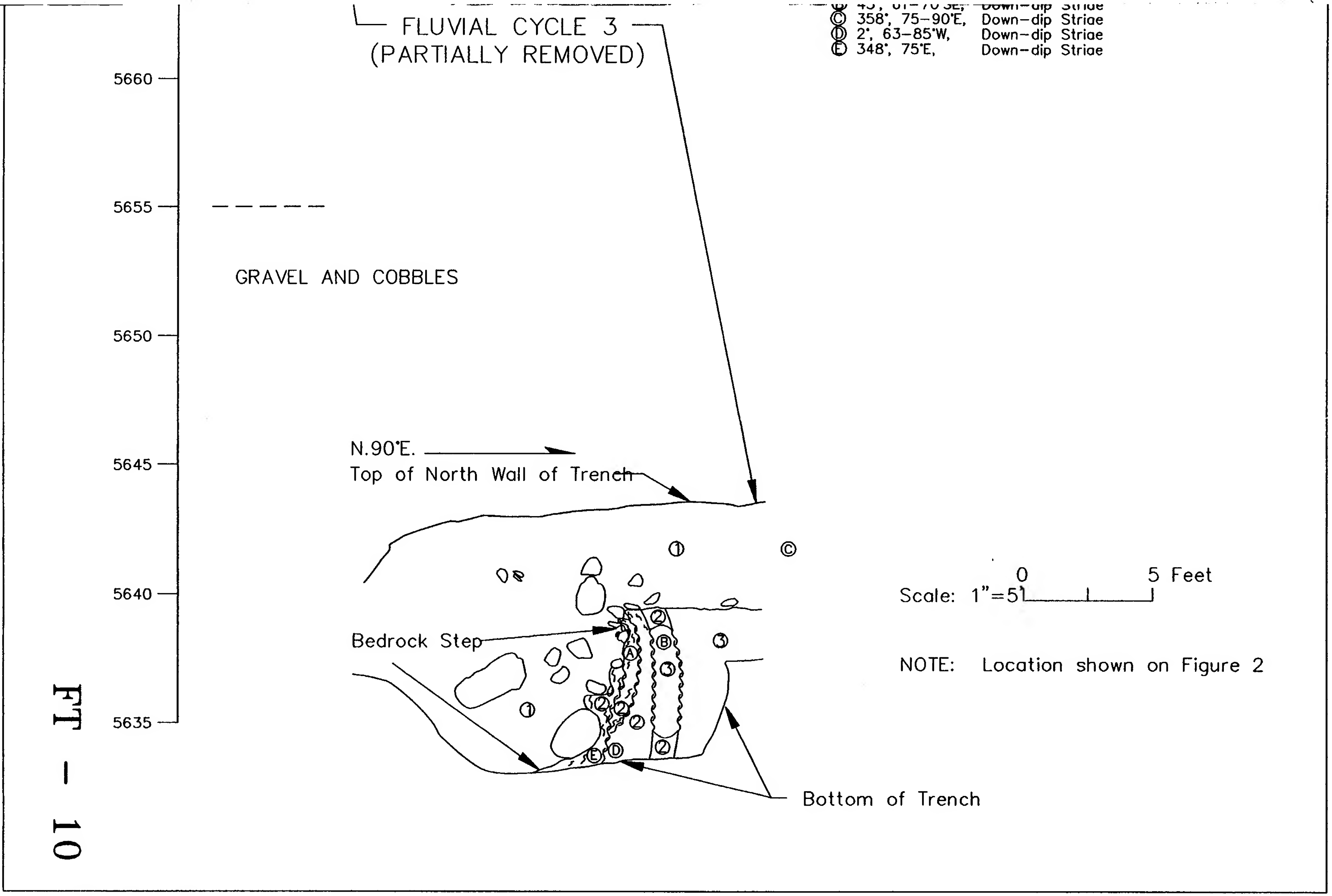
① Gravel, Cobbles and Boulders, rounded clasts in a matrix of silty sand, moderate reddish brown (10R, 6/6) dense, slightly friable

Frontier Formation

② Clay (gouge?), dark yellowish brown (10YR, 4/2)



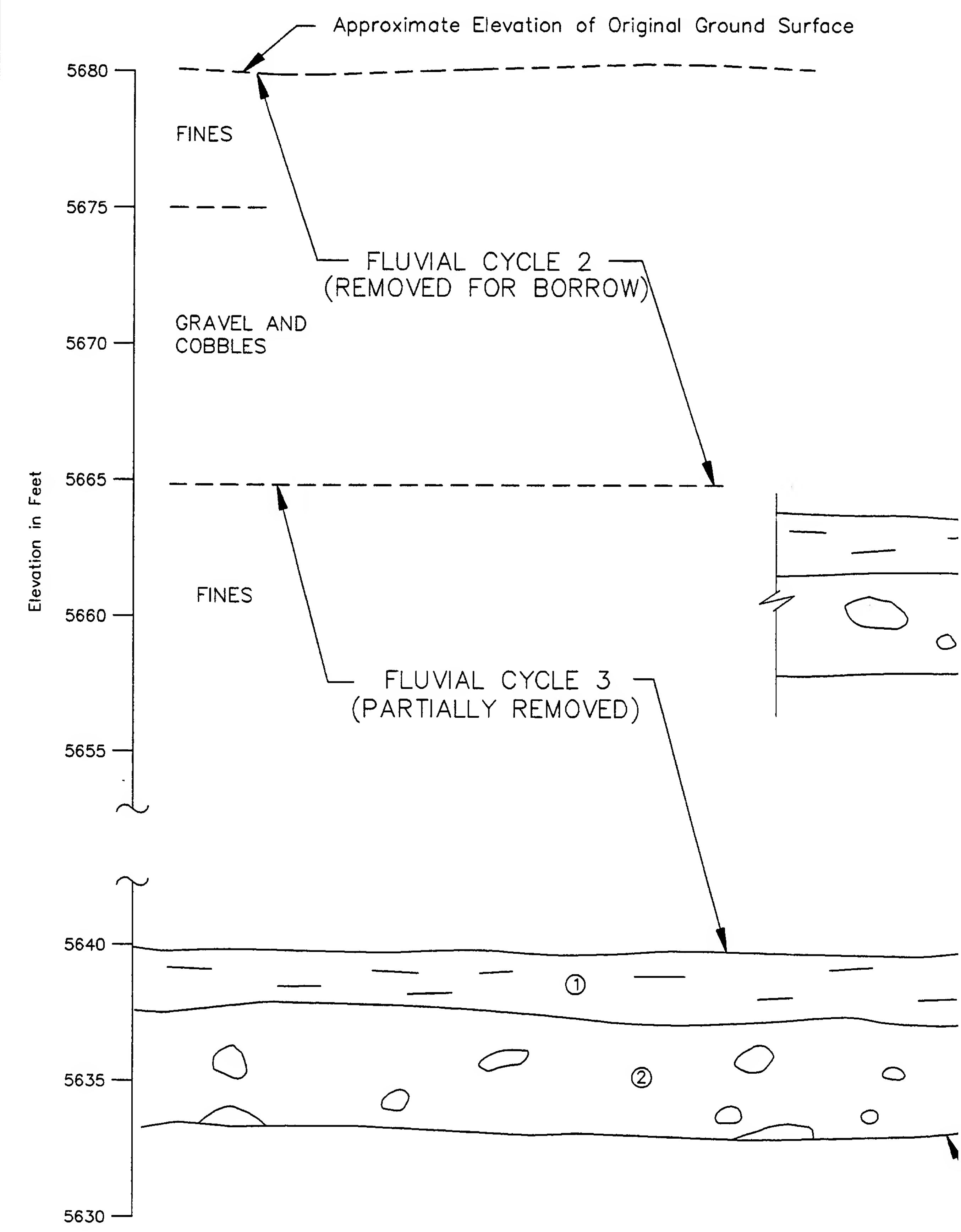
5675
5670
5665
5660
5655
5650
5645
5640
5635
FINES
GRAVEL AND COBBLES
FLUVIAL CYCLE 3
(PARTIALLY REMOVED)
N.90°E.
Top of North Wall of Trench
Bedrock Step
①
②
③
Ⓐ
Ⓑ
Ⓒ
DESCRIPTION
Alluvium
① Gravel, Cobbles and Boulders, rounded clasts in a matrix of silty sand, moderate reddish brown (10R, 6/6) dense, slightly friable
Frontier Formation
② Clay (gouge?), dark yellowish brown (10YR, 4/2) sheared, very soft
③ Claystone, yellowish gray (5Y, 2/2), soft, intensely fractured iron and manganese coated fracture surfaces, possible altered ash bed
ATTITUDES (360° Compass)
Ⓐ 53°, 50–72°SE, Down-dip Striae
Ⓑ 45°, 61–70°SE, Down-dip Striae
Ⓒ 358°, 75–90°E, Down-dip Striae
Ⓓ 2°, 63–85°W, Down-dip Striae
Ⓔ 348°, 75°E, Down-dip Striae
0
5 Feet
Scale: 1"=5'
NOTE: Location shown on Figure 2



C 358°, 75–90°E, Down-dip Striae
D 2°, 63–85°W, Down-dip Striae
E 348°, 75°E, Down-dip Striae
FLUVIAL CYCLE 3
(PARTIALLY REMOVED)
5660
5655
5650
5645
5640
5635
GRAVEL AND COBBLES
N.90°E.
Top of North Wall of Trench
Bedrock Step
Bottom of Trench
Scale: 1"=5'
0
5 Feet
NOTE: Location shown on Figure 2
FT – 10

Figure 11

Logged by: B.A. Bryant Date: 9/13/92



urface

DESCRIPTION

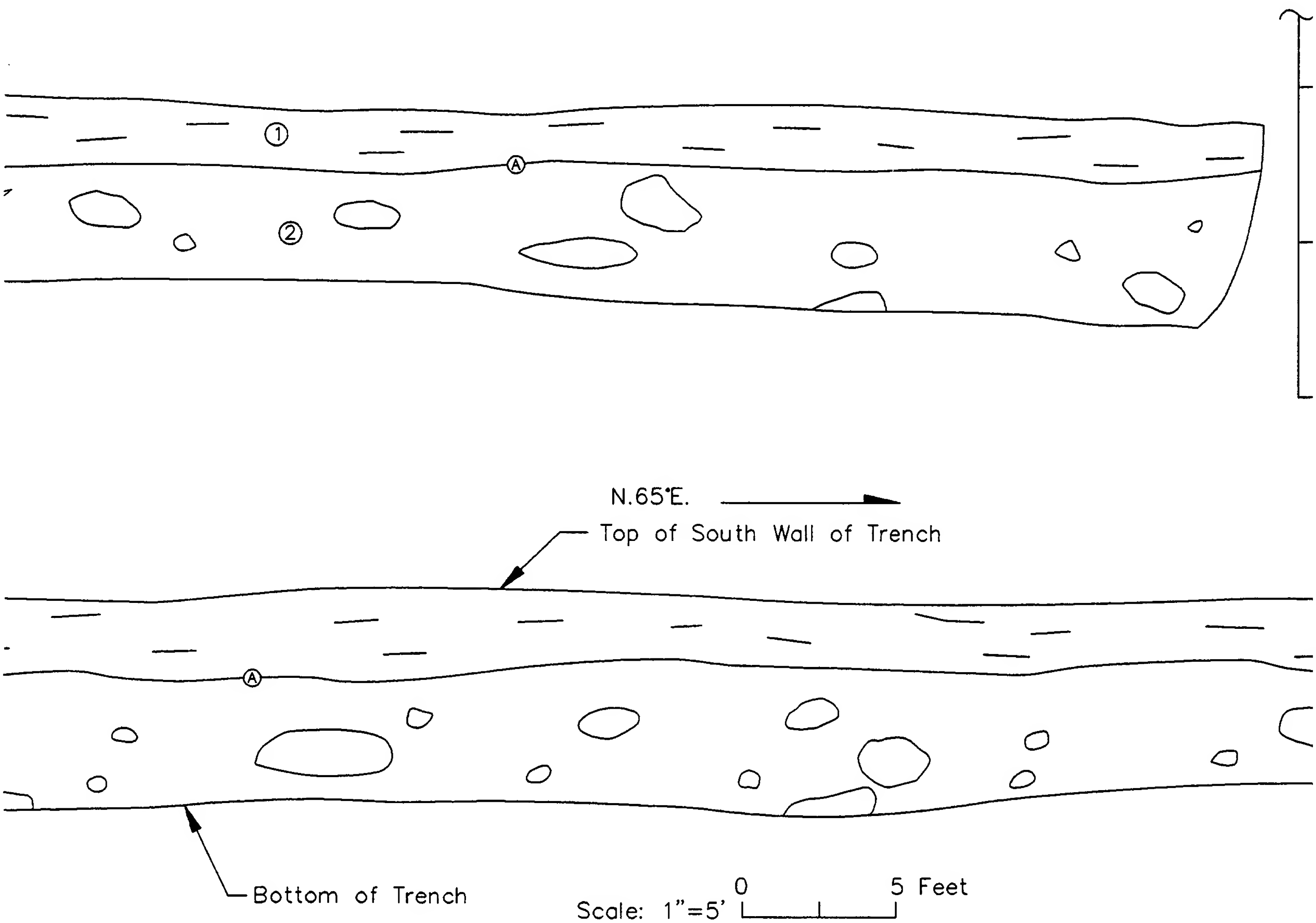
Alluvium

① Sandy clay, moderate brown (5YR, 4/4), very stiff, scattered rounded and angular gravel

② Cobbly gravel, scattered boulders to 18"-diameter, rounded to subrounded clasts, poorly sorted; matrix is silty sand, moderate reddish brown (10YR, 4/6), dense

ATTITUDES (360° Compass)

Ⓐ Near horizontal, sharp, undulatory contact



Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT –

DESCRIPTION

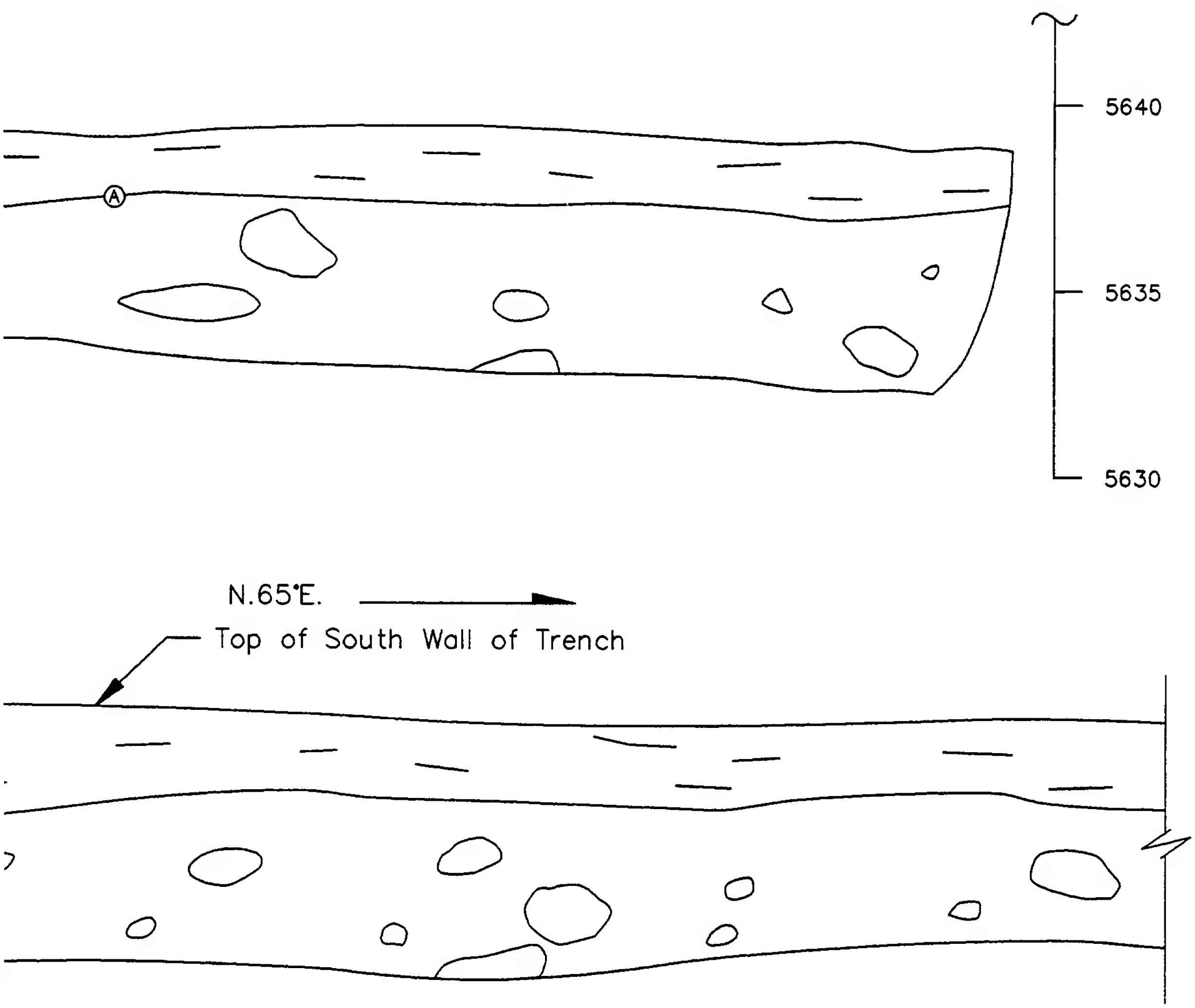
ium

ndy clay, moderate brown (5YR, 4/4), very stiff, scattered rounded
d angular gravel

bbly gravel, scattered boulders to 18"-diameter, rounded to
›rounded clasts, poorly sorted; matrix is silty sand, moderate
dish brown (10YR, 4/6), dense

'UDES (360° Compass)

ɔr horizontal, sharp, undulatory contact



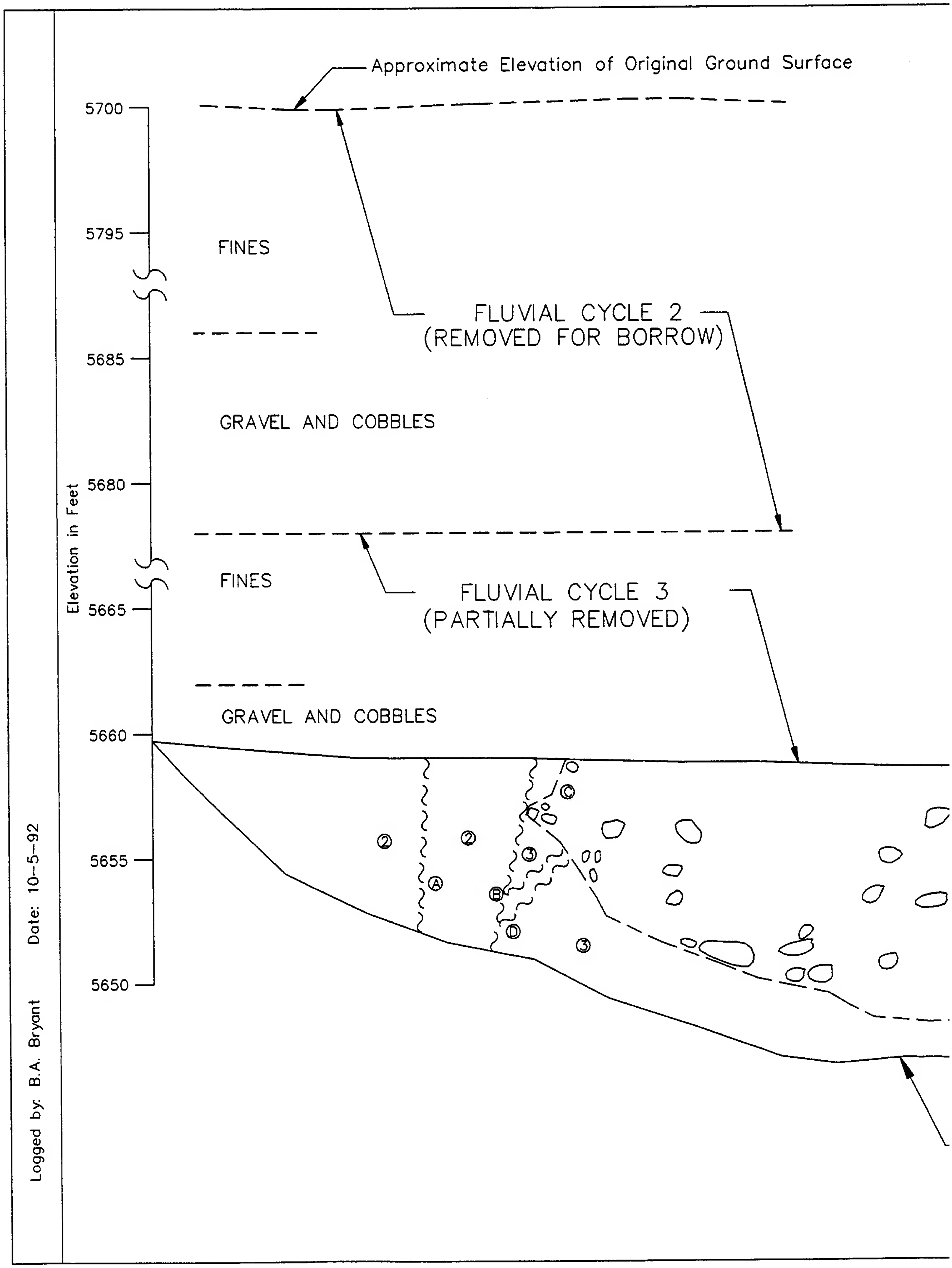
ɪnch

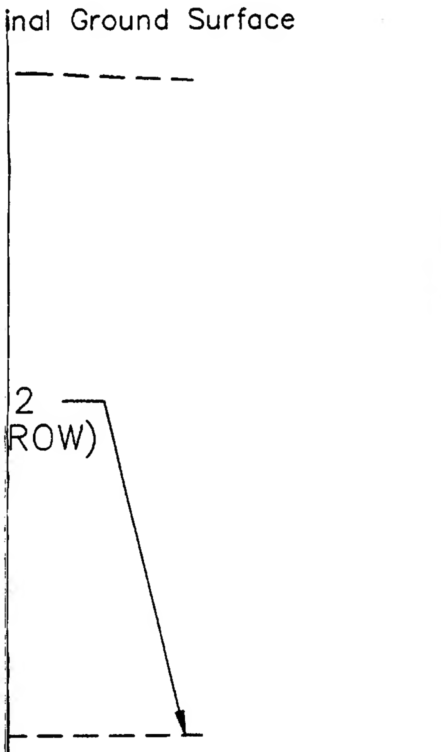
Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 11

Figure 12


Approximate Elevation of Original Ground Surface
5700
5795
5685
5680
5665
5660
5655
5650
Elevation in Feet
FINES
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
GRAVEL AND COBBLES
FINES
FLUVIAL CYCLE 3
(PARTIALLY REMOVED)
GRAVEL AND COBBLES
2
2
3
3
A
B
C
D
Logged by: B.A. Bryant Date: 10-5-92



ATTITUDES (360° Compass)

Ⓐ	28°, 82–90° W (downdip straie)	Shear
Ⓑ	28°, 73° E (downdip straie)	Fault
Ⓒ	15°, 42° E (downdip straie)	Shear
Ⓓ	49°, 60° SE	Shear
Ⓔ	56°, 74° W	Shear
Ⓕ	20°, 70–90° W	Shear
	60°, 55° W (generalized)	Shear
	60°, 25° E (generalized)	

DESCRIPTION

Alluvium

① Cobbly gravel, scattered boulders to 24 to matrix supported; matrix is silty sar rounded to subrounded clasts, poorly s manganese brown (10YR, 5/4) with sor gray (5Y, 8/1) mottling, dense, scatter oxide staining

Frontier Formation

② Silty sandstone, yellowish gray (5Y, 7/2 moderately hard, moderately fractured,

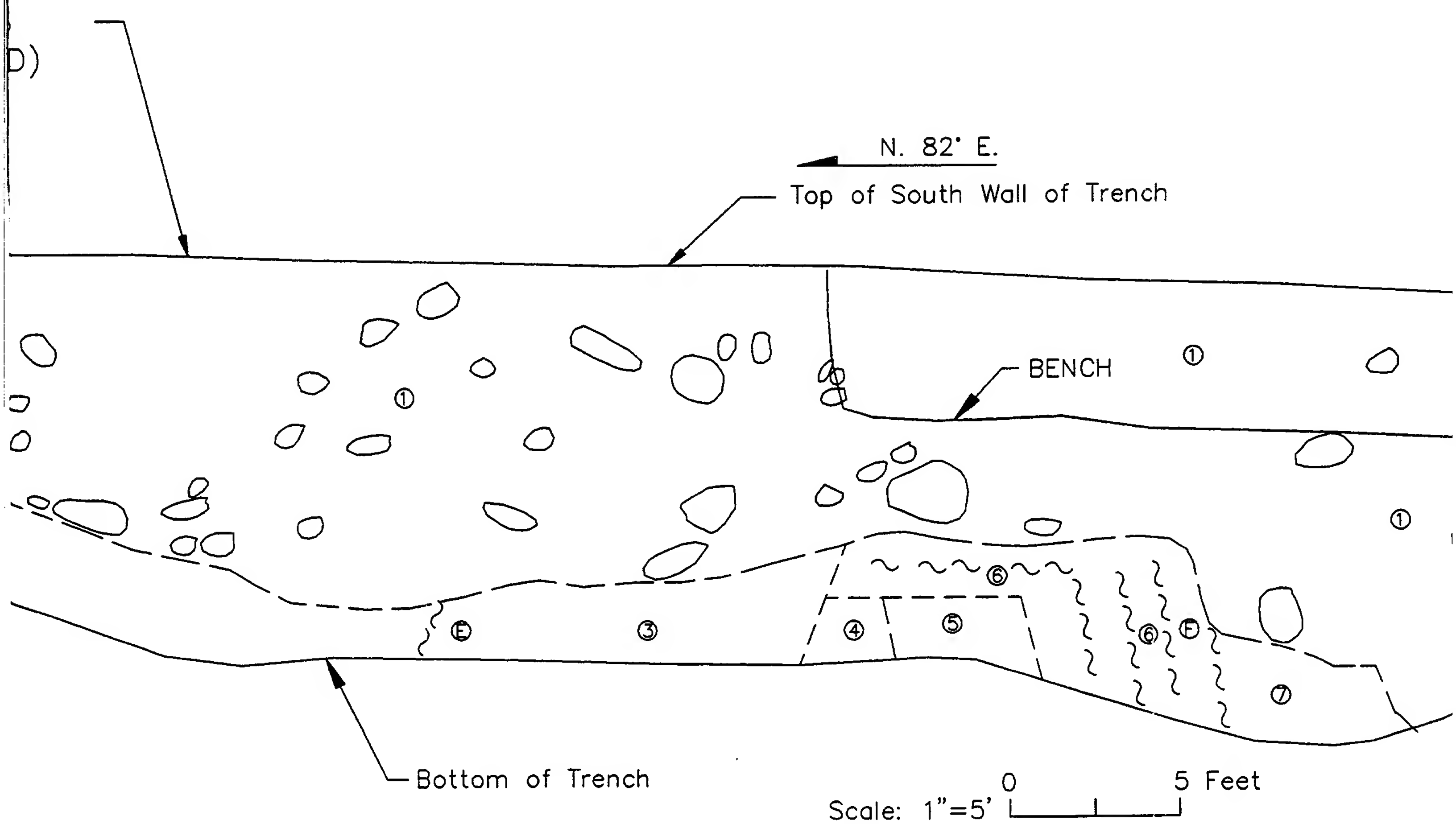
③ Clayey siltstone, dark yellowish orange soft, to soft, moderately to highly frac

④ Sandstone, pinkish gray (5YR, 8/1), ha fractured.

⑤ Same as ③ above

⑥ Claystone (altered/sheared?), grayish y with black (N1) flecks, soft to very sof intensely sheared.

⑦ Silty claystone, dark reddish brown (10F intensely fractured, some shearing



NOTE: Location shown on Figure 2

DESCRIPTION

Alluvium

① Cobbly gravel, scattered boulders to 24"–diameter, to matrix supported; matrix is silty sand, scattered rounded to subrounded clasts, poorly sorted, clast manganese brown (10YR, 5/4) with some yellowish gray (5Y, 8/1) mottling, dense, scattered manganese oxide staining

Frontier Formation

② Silty sandstone, yellowish gray (5Y, 7/2), moderately soft to moderately hard, moderately fractured, some apparent bedding

③ Clayey siltstone, dark yellowish orange (10YR, 6/6), moderately soft, to soft, moderately to highly fractured

④ Sandstone, pinkish gray (5YR, 8/1), hard, moderately to highly fractured.

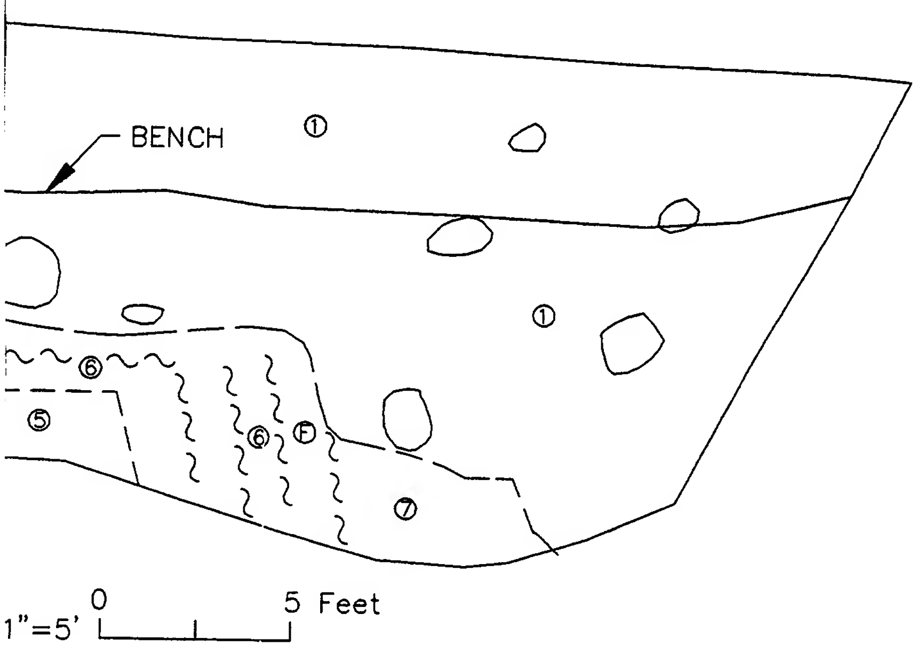
⑤ Same as ③ above

⑥ Claystone (altered/sheared?), grayish yellow green (5GY, 7/2) with black (N1) flecks, soft to very soft (when moist), intensely sheared.

⑦ Silty claystone, dark reddish brown (10R, 3/4), moderately soft intensely fractured, some shearing

82° E.

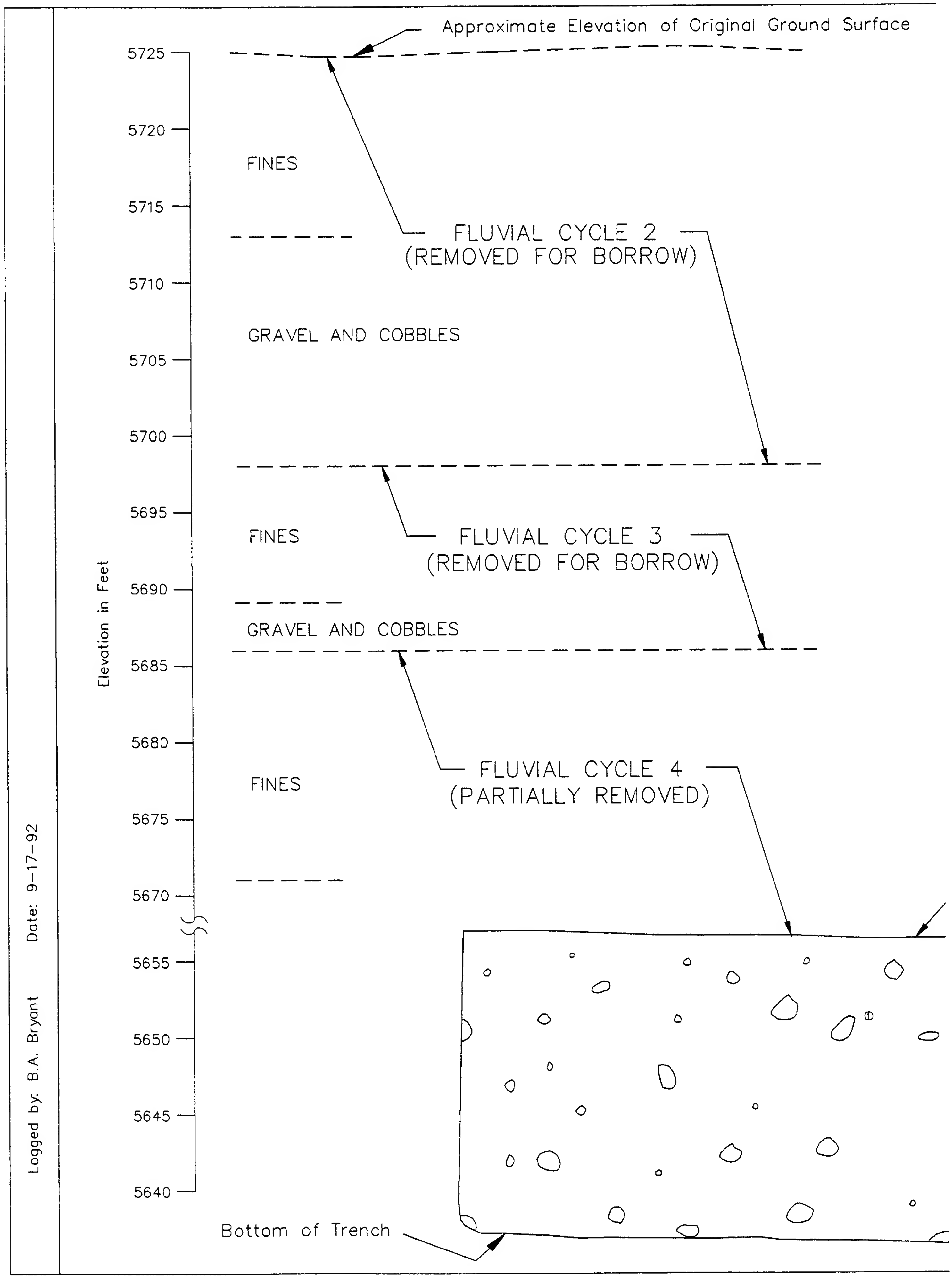
outh Wall of Trench

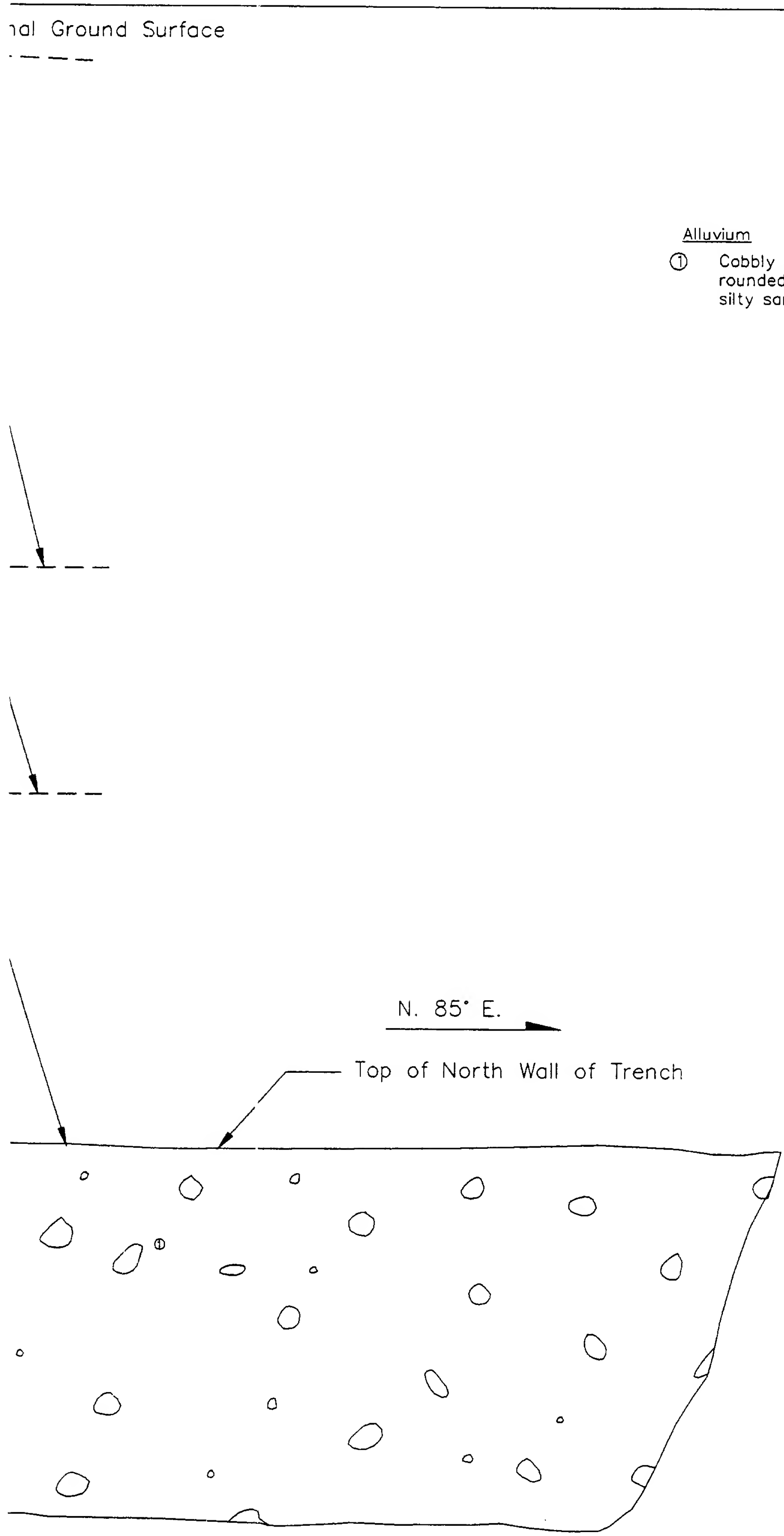


Location shown on Figure 2

FT – 12

Figure 13


Logged by: B.A. Bryant
Date: 9-17-92
Elevation in Feet
Approximate Elevation of Original Ground Surface
5725
5720
5715
5710
5705
5700
5695
5690
5685
5680
5675
5670
5655
5650
5645
5640
FINES
GRAVEL AND COBBLES
FINES
GRAVEL AND COBBLES
FINES
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
FLUVIAL CYCLE 3
(REMOVED FOR BORROW)
FLUVIAL CYCLE 4
(PARTIALLY REMOVED)
Bottom of Trench



Alluvium

1 Cobbly gravel, scattered small boulders to 24"–diameter, rounded to subrounded clasts, poorly sorted; matrix is silty sand, moderate reddish brown (10R, 4/6), dense, moist.

Scale: 1"=8' 0 8 Fee

NOTE: Location shown on Figu

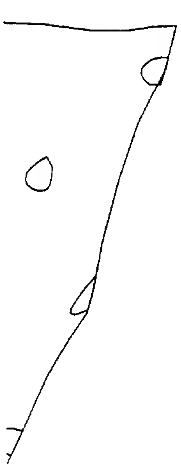
FT

Figur

Alluvium

① Cobbly gravel, scattered small boulders to 24"–diameter, rounded to subrounded clasts, poorly sorted; matrix is silty sand, moderate reddish brown (10R, 4/6), dense, moist.

nch

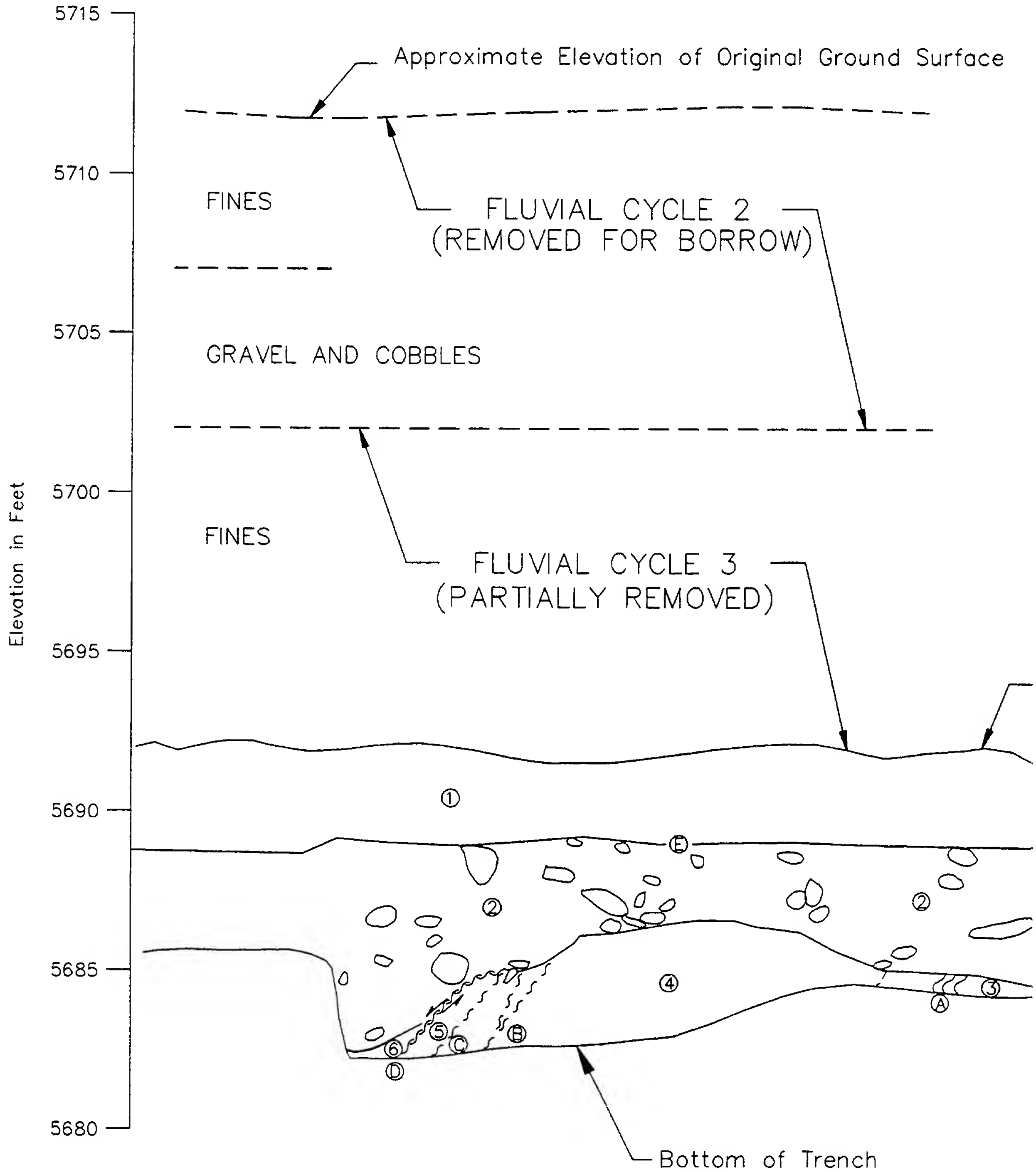


Scale: 1"=8'   0 ——— 8 Feet

NOTE: Location shown on Figure 2

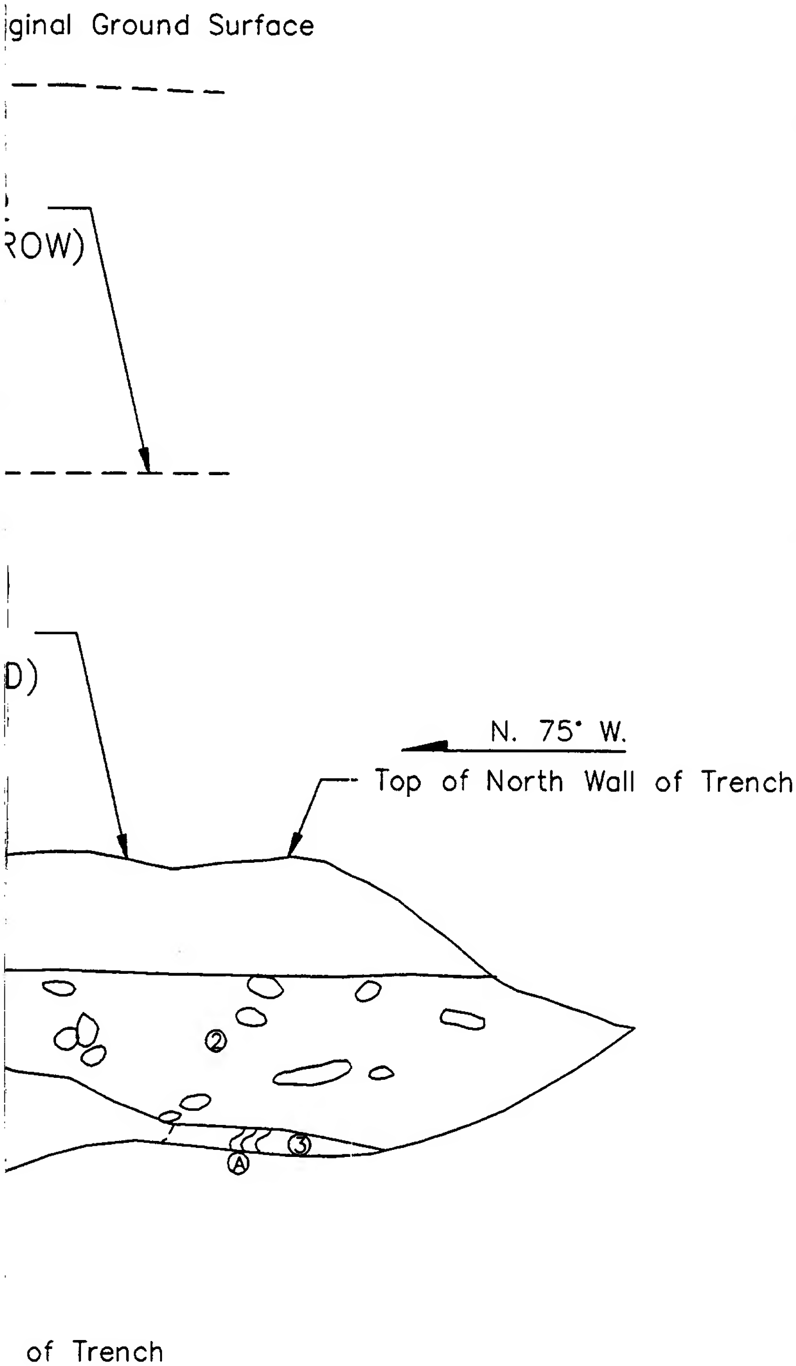
FT – 13

Figure 14



Logged by: B.A. Bryant

Date: 9-30-92



DESCRIPTION

Alluvium

① Sandy clay, moderate brown (5YR, 4/4), dense, scattered rounded angular gravel, some small pores, decayed root and rootlet channel ancestral desiccation cracks? (paleosol?)

② Cobbly gravel, rounded to subrounded cobbles, scattered small boul to 18"–diameter, poorly sorted, matrix to clast supported; matrix i sand, grayish orange pink (5YR, 7/2) with manganese oxide stainec (dark gray – N3)

Frontier Formation

③ Claystone, greenish gray (5GY, 6/1) with very dark red (5R, 2/6) n soft to very soft, intensely fractured to sheared

④ Sandy siltstone to silty sandstone, pale brown (5YR, 5/2), moderat to soft, moderately to intensely fractured

⑤ Sandstone, very light gray (NB), moderately hard, highly fractured w (clay lined)

⑥ Same as ③

ATTITUDES (360° Compass)

Ⓐ	35°, 80° W	Shea
Ⓑ	45°, 80° to 90° NW	Shea
Ⓒ	64°, 77° N	Shea
Ⓓ	27°, 43° W	Shea
Ⓔ	Undulatory, near horizontal	Cont

Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT

Fig

e

DESCRIPTION

Alluvium

① Sandy clay, moderate brown (5YR, 4/4), dense, scattered rounded and angular gravel, some small pores, decayed root and rootlet channels, ancestral desiccation cracks? (paleosol?)

② Cobbly gravel, rounded to subrounded cobbles, scattered small boulders to 18"-diameter, poorly sorted, matrix to clast supported; matrix is silty sand, grayish orange pink (5YR, 7/2) with manganese oxide stained (dark gray – N3)

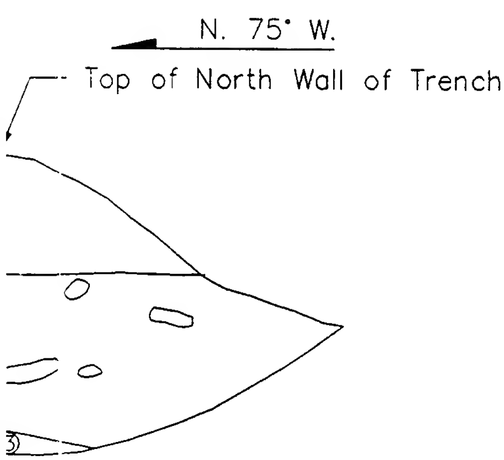
Frontier Formation

③ Claystone, greenish gray (5GY, 6/1) with very dark red (5R, 2/6) mottling soft to very soft, intensely fractured to sheared

④ Sandy siltstone to silty sandstone, pale brown (5YR, 5/2), moderately soft to soft, moderately to intensely fractured

⑤ Sandstone, very light gray (N8), moderately hard, highly fractured with shears (clay lined)

⑥ Same as ③



ATTITUDES (360° Compass)

Ⓐ	35°, 80° W	Shear
Ⓑ	45°, 80° to 90° NW	Shear
Ⓒ	64°, 77° N	Shear
Ⓓ	27°, 43° W	Shear
Ⓔ	Undulatory, near horizontal	Contact

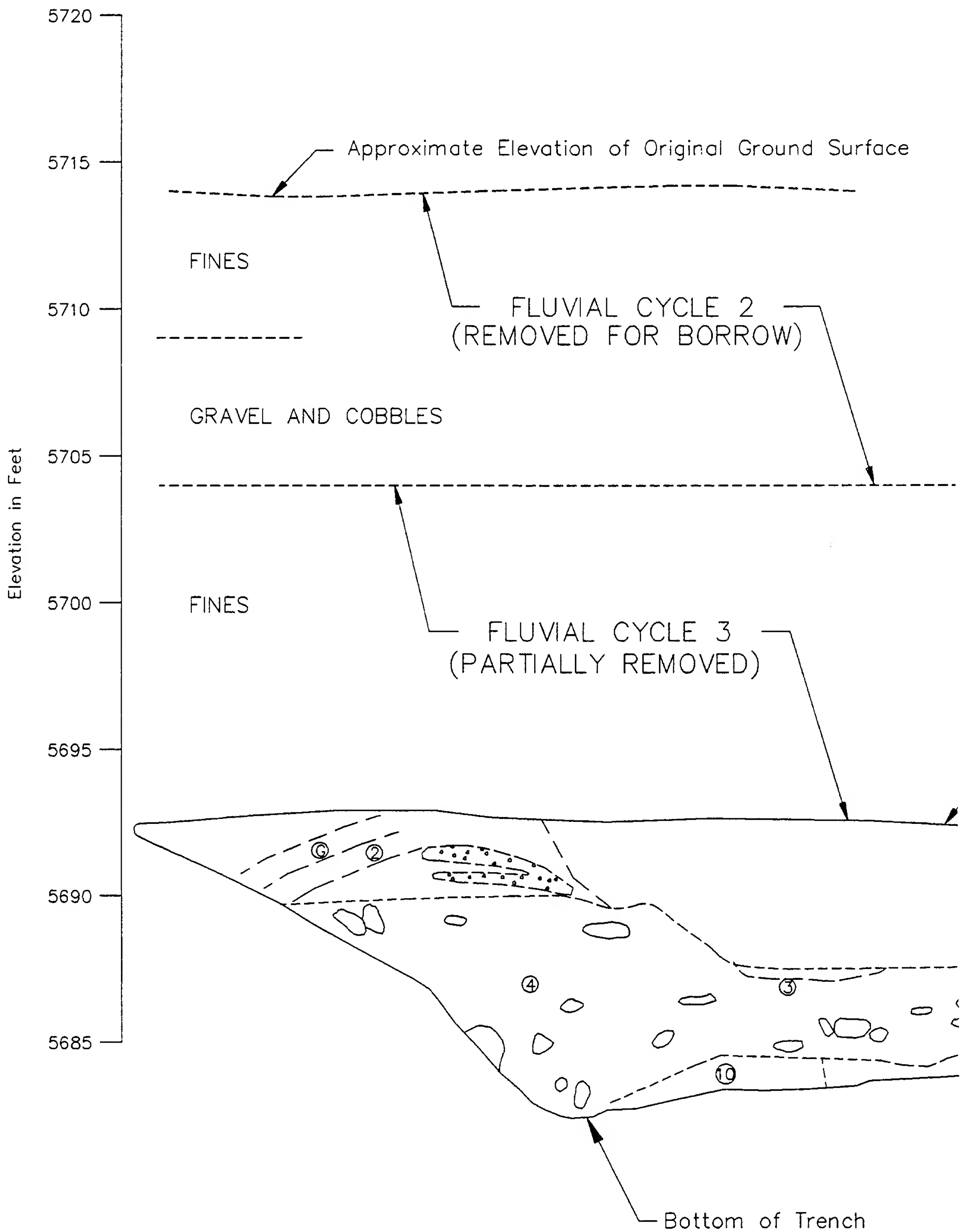
Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 14

Figure 15

Logged by: B.A. Bryant Date: 9-30-92



face

DESCRIPTION

Alluvium

① Sandy, clay, moderate brown (5YR, 4/4), very soft when wet, scattered angular and rounded gravel

② Silty fine sand, light brown (5YR, 6/4), with scattered light gray (N7) mottling, dense, friable, scattered thin gravel beds

③ Clayey silty fine sand, moderate reddish brown (10R, 4/6), with thin brownish black (5YR, 2/1) beds, scattered fine gravel, dense, moderately cohesive.

④ Gravel, poorly sorted with gravel to small boulder sized clasts matrix to clast supported, clasts are rounded to subrounded, abundant meta-sedimentary clasts; matrix is silty sand, moderate reddish orange (10R, 6/6), with scattered areas that appear to be manganese oxide stained.

Frontier Formation

⑤ Claystone (altered tuff?), greenish gray (5GY, 6/1), very soft (when moist), intensely sheared

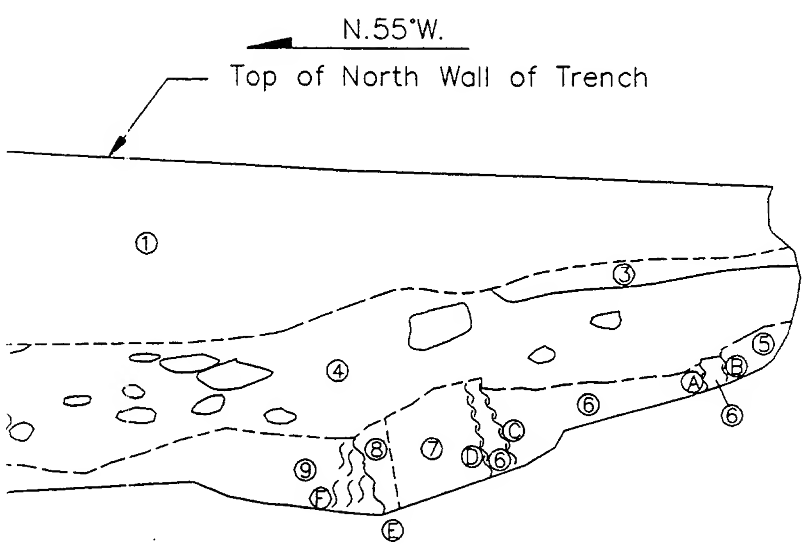
⑥ Clayey siltstone, moderate brown (5YR, 3/4), soft to very soft, highly to intensely fractured

⑦ Same as ⑤

⑧ Silty fine sandstone, light gray (N7) with dusky yellow (5Y, 6/4) banding, very dense, soft (weathered?)

⑨ Siltstone, mottled dusky yellow (5Y, 6/4) and greenish gray (5GY, 6/1), soft, highly fractured

⑩ Clayey siltstone, mottled moderate reddish brown (10R, 4/6) and greenish gray (5GY, 6/1), moderately soft, intensely fractured



ATTITUDES (360° Compass)

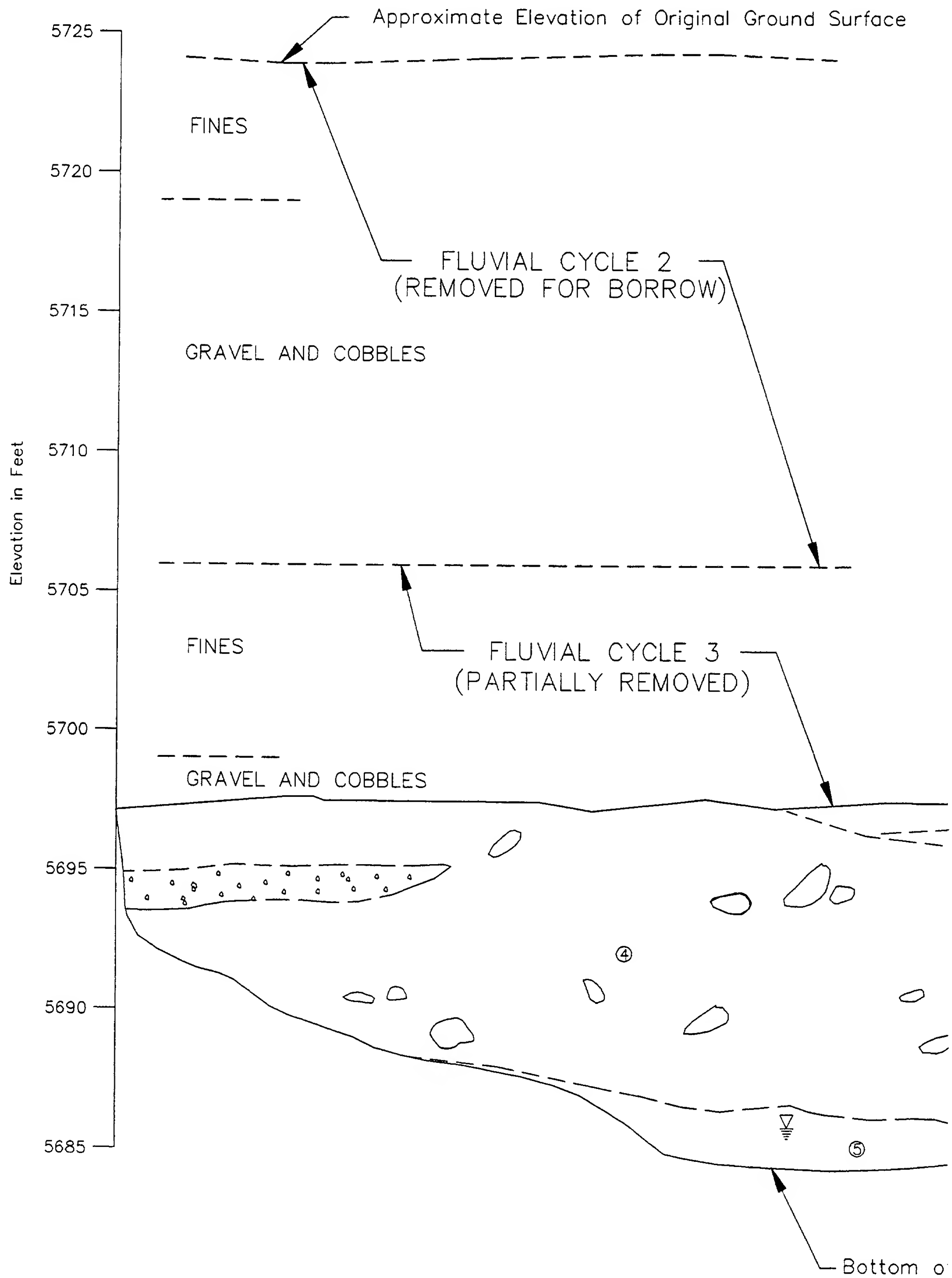
Ⓐ	5°, 72°E,	Shear
Ⓑ	39°, 71°E,	Shear
Ⓒ	32°, 61°N,	Shear
Ⓓ	22°, 68°N,	Shear
Ⓔ	15°, 40–72°E	Shear
Ⓕ	19°, 68°E	Shear
Ⓖ	60°, 15–20°NW,	Bedding

Scale: 1"=5' 0 — 5 Feet

NOTE: Location shown on Figure 2

FT – 15

Figure 16



Logged by: B.A. Bryant Date: 9-21-92

DESCRIPTION

Alluvium

① Silty fine sand, moderate reddish orange (10R, 6/6), massive, friable, dense

② Sandy clay, dark yellowish brown, (10YR, 4/2)

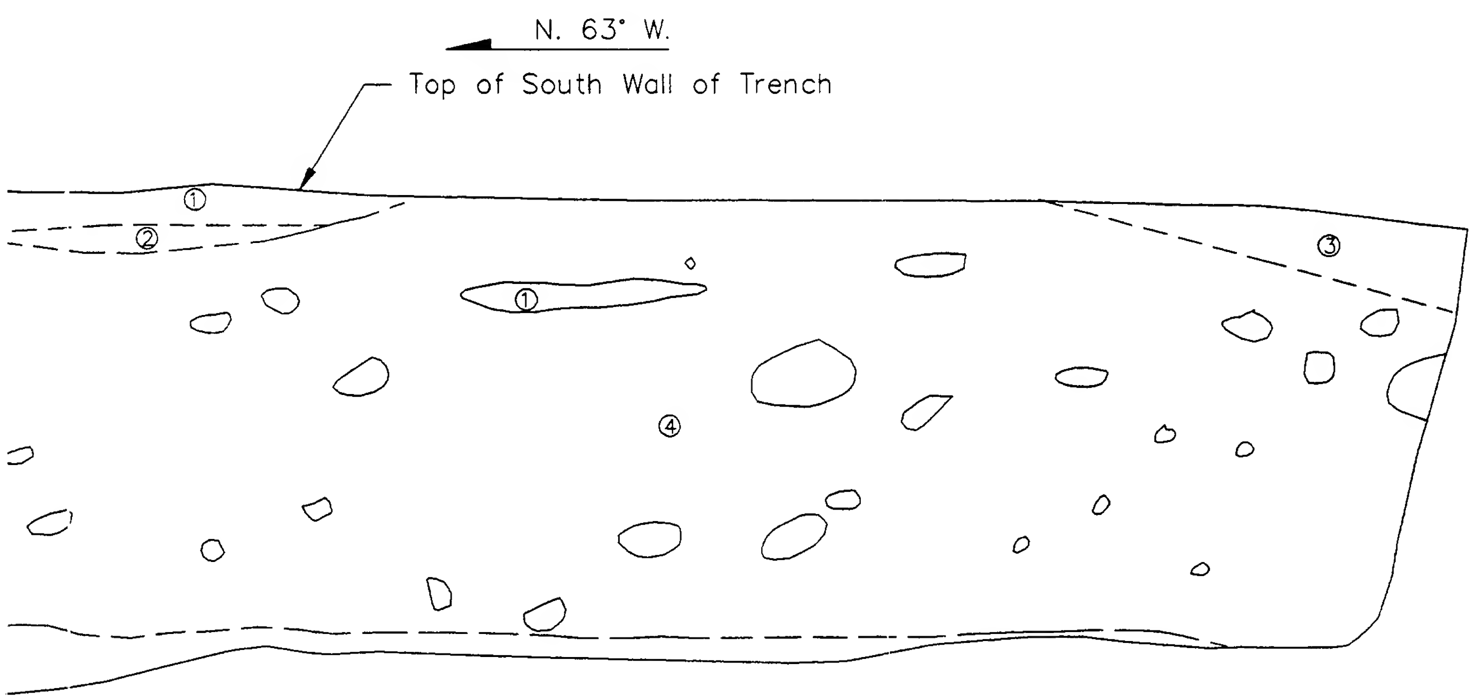
③ Clayey silt, pale olive (10YR, 6/2)

④ Gravel, rounded boulders to 18"-diameter, clast supported; matrix is silty sand, moderate brown (5YR, 4/4), dense,; some sand and gravel channels

Frontier Formation

⑤ Claystone to siltstone, pale olive (10YR, 6/2), to moderate reddish brown (10YR, 11/6), claystone is sheared, siltstone highly fractured, very soft to moderately soft.

⊻ Elevation of groundwater on 9-21-92



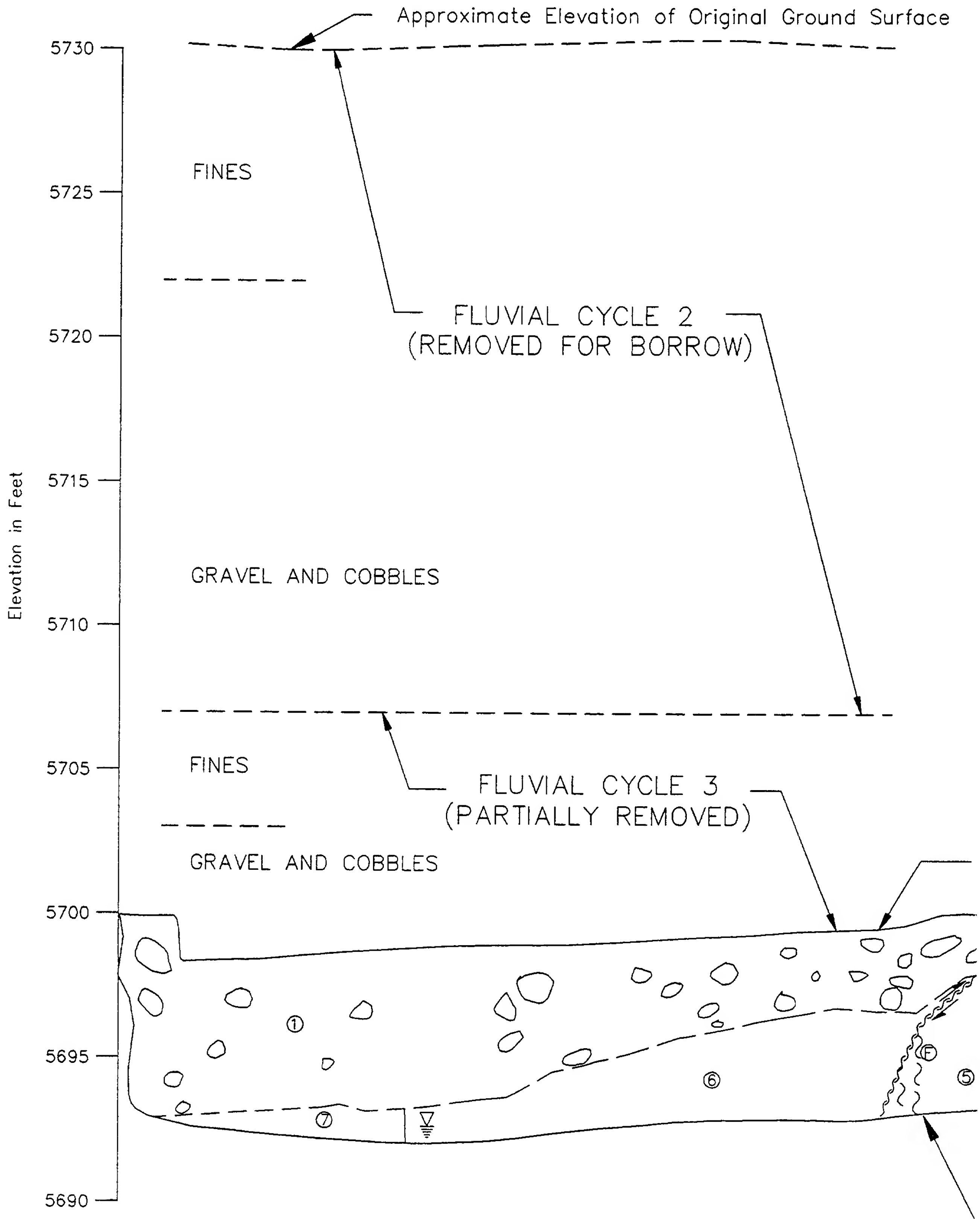
m of Trench

Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 16

Figure 17



Logged by: B.A. Bryant Date: 9-21-92

Surface

DESCRIPTION

Alluvium

① Cobbly gravel, scattered small boulders to 18"–diameter, cobbles are sub–rounded to rounded, matrix to clast suported; matrix is silty sand, light brown (5YR, 6/4), dense

Frontier Formation

② Clayey siltstone, mottled light brown (5YR, 5/6) and pale olive (10YR, 6/2), moderately hard to moderately soft, intensely fractured

③ Claystone (altered tuff?), grayish green (10GY, 5/2), with moderate reddish brown (10YR, 4/6) mottling, moderately soft to very soft (when moist), intensely fractured with shearing

④ Silty fine sandstone to fine sandy siltstone, pale reddish brown (10R, 5/4), moderately soft to moderately hard, highly fractured with some shear zones

⑤ Same as ③

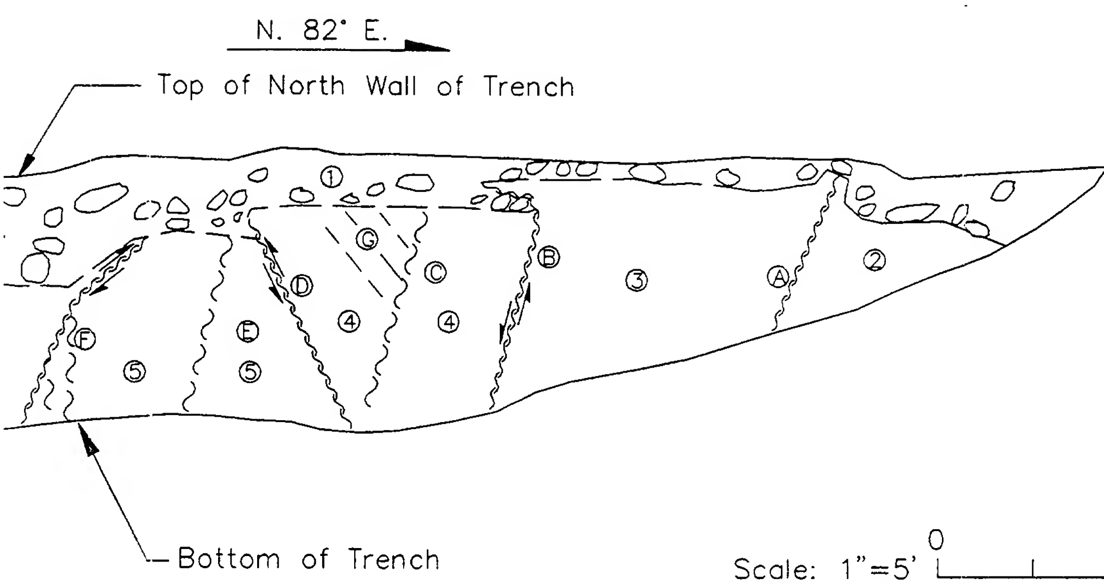
⑥ Same as ②

⑦ Same as ④

▽ Elevation of groundwater on 9–21–92

ATTITUDES (360° Compass)

Ⓐ	35°, 80° W	Shear/Contact
Ⓑ	45°, 80° to 90° NW	Fault
Ⓒ	64°, 77° N	Shear
Ⓓ	27°, 43° W	Fault
Ⓔ	Undulatory, near horiz.	Shear
Ⓕ	20°–50°, 60°–90° W	Fault
Ⓖ	344°, 56° N	Fault

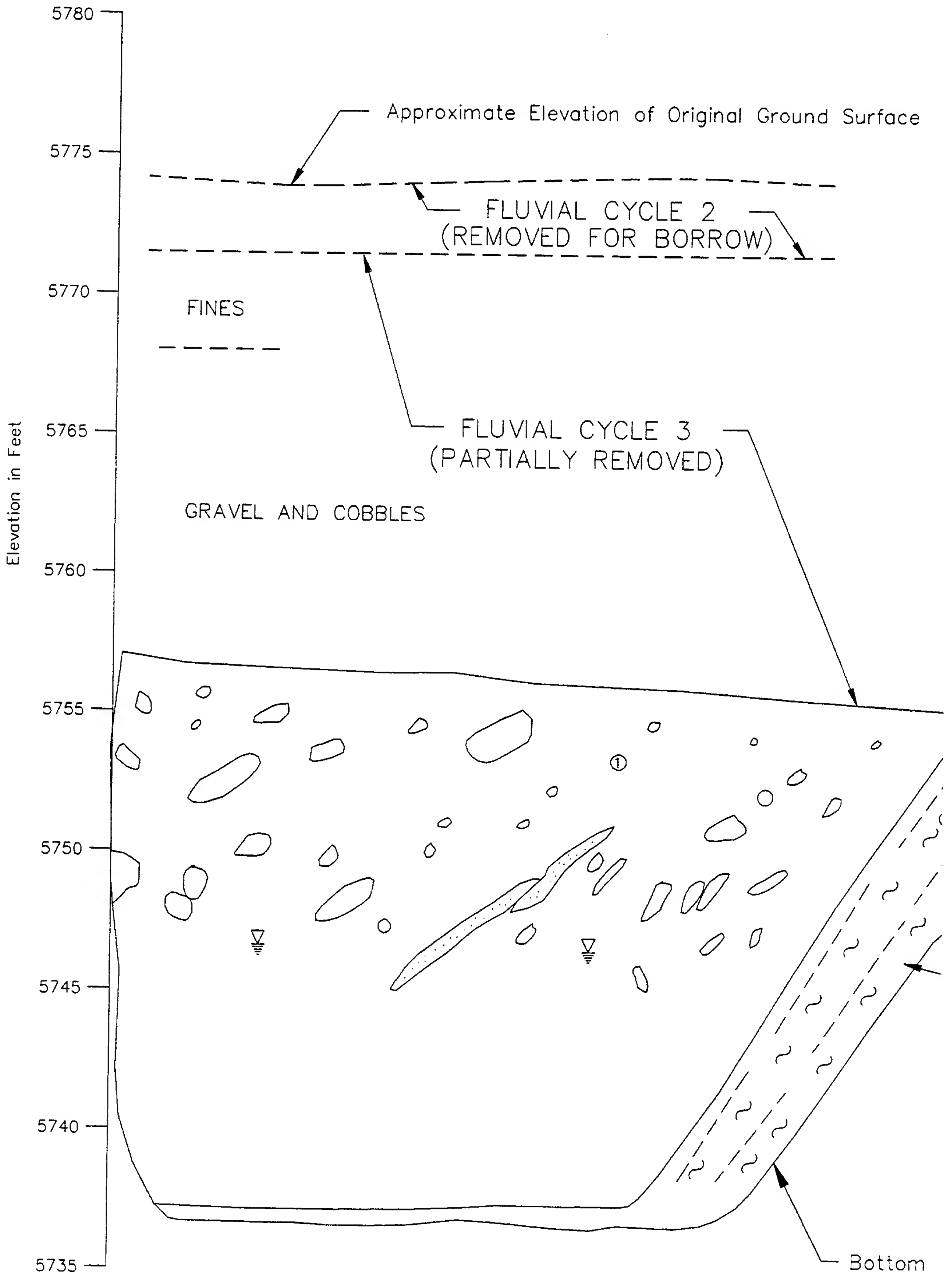


Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 17

Figure 18



Logged by: B.A. Bryant Date: 9-21-92

e

DESCRIPTION

Alluvium

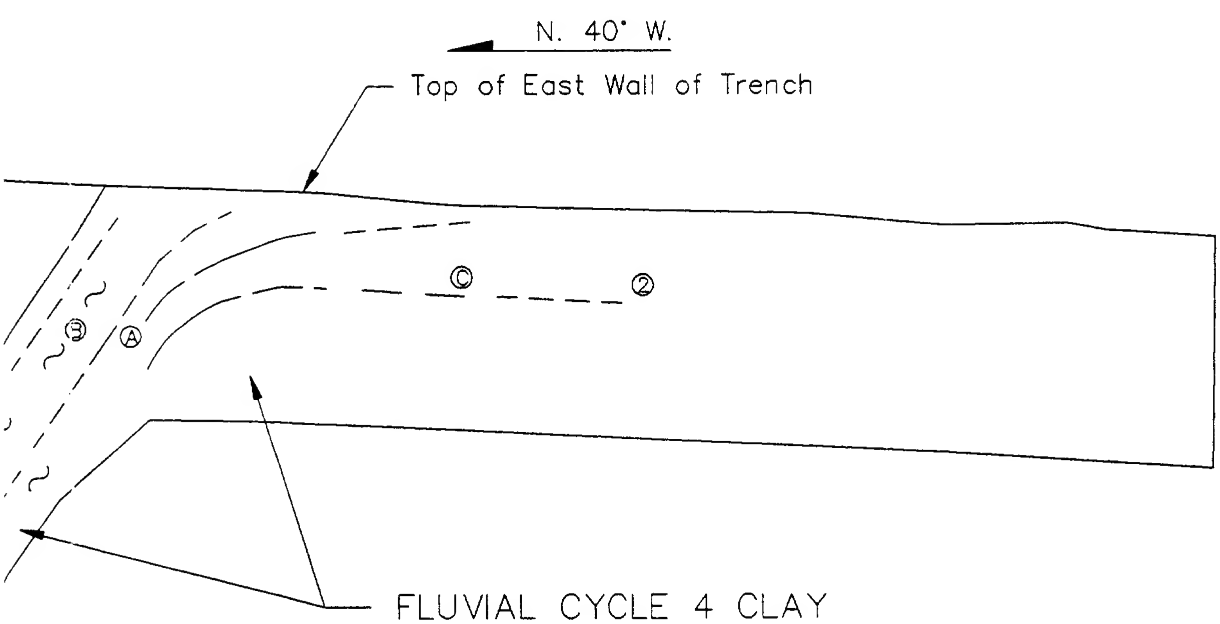
① Cobbly gravel, scattered small boulders to 24"–diameter, rounded to subrounded clasts, poorly sorted; matrix is silty sand, light brown (5YR, 6/4), dense, moist to saturated; scattered gravel and sand horizons

② Sandy clay, pale orange brown with white flecks, moist to wet, very firm, scattered gravel

∇ Elevation of groundwater on 9–21–92

ATTITUDES (360° Compass)

Ⓐ	35°, 38° W	Shear/bedding
Ⓑ	37°, 43° W	Shear/bedding
Ⓒ	270°, ~ 5° N	Bedding



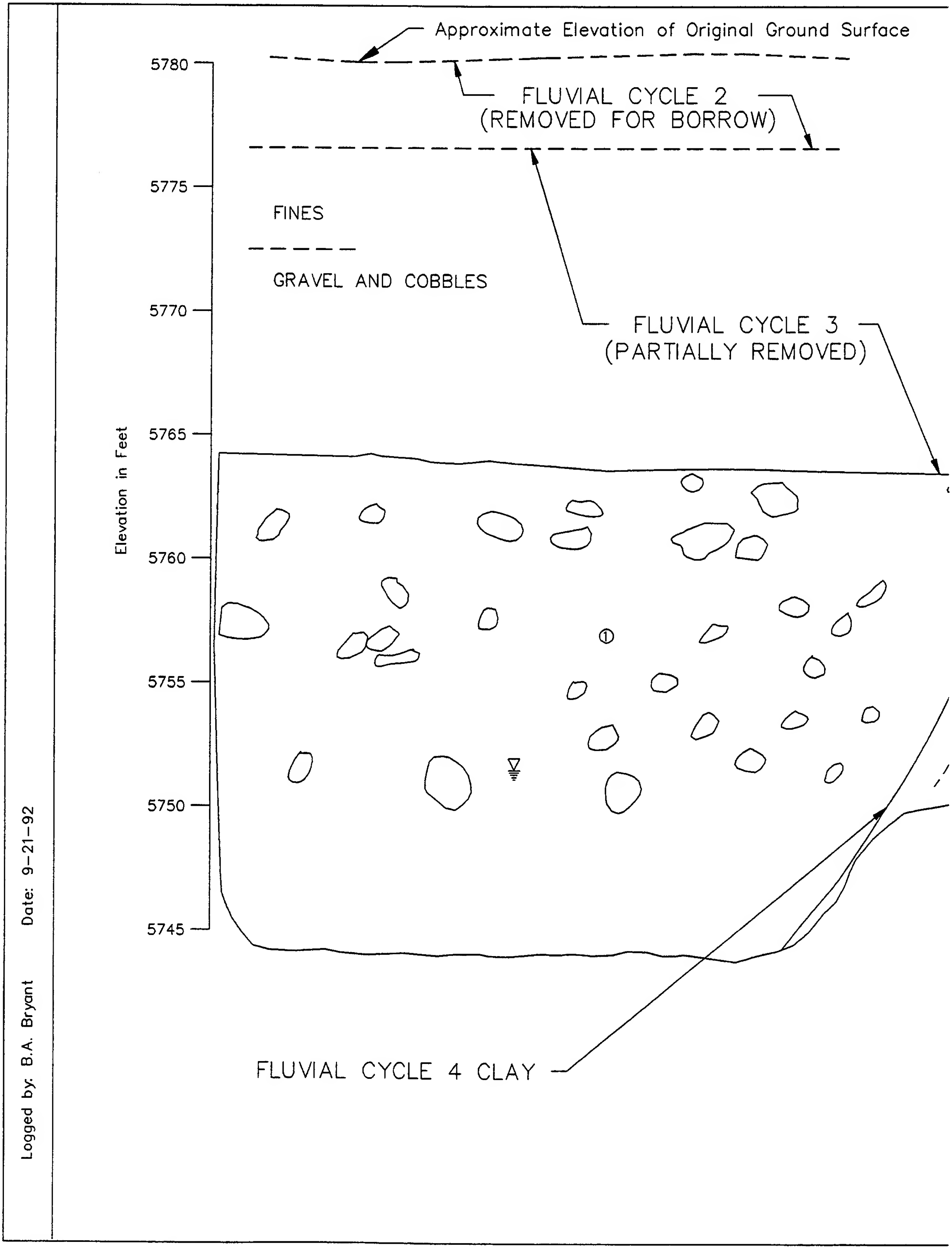
Scale: 1"=5' 0 5 Feet

tom of Trench

NOTE: Location shown on Figure 2

FT – 18

Figure 19


Approximate Elevation of Original Ground Surface
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
5780
5775
5770
5765
5760
5755
5750
5745
Elevation in Feet
FINES
GRAVEL AND COBBLES
FLUVIAL CYCLE 3
(PARTIALLY REMOVED)
①
FLUVIAL CYCLE 4 CLAY
Logged by: B.A. Bryant
Date: 9-21-92

face

DESCRIPTION

Alluvium

① Cobbly gravel, scattered small boulders to 24"–diameter, subrounded to rounded clasts, poorly sorted; matrix is silty sand, light brown (5YR, 6/4), dense, moist to saturated

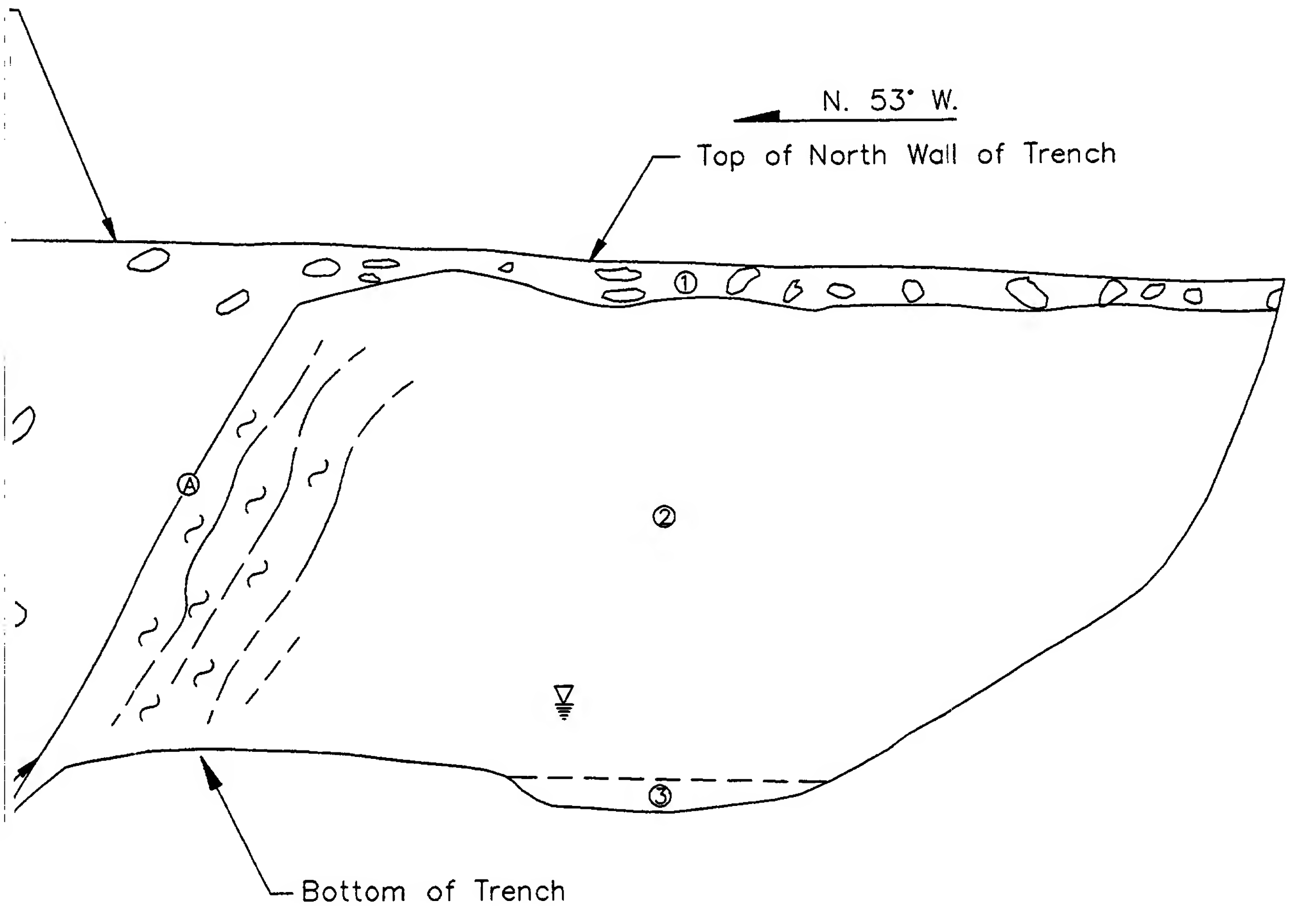
② Sandy clay, pale orange brown, very firm, moist to wet, some shearing

③ Cobbly gravel

▽ Elevation of groundwater on 9–21–92

ATTITUDES (360° Compass)

Ⓐ 30°, 50° W (approximate) Contact and Shear



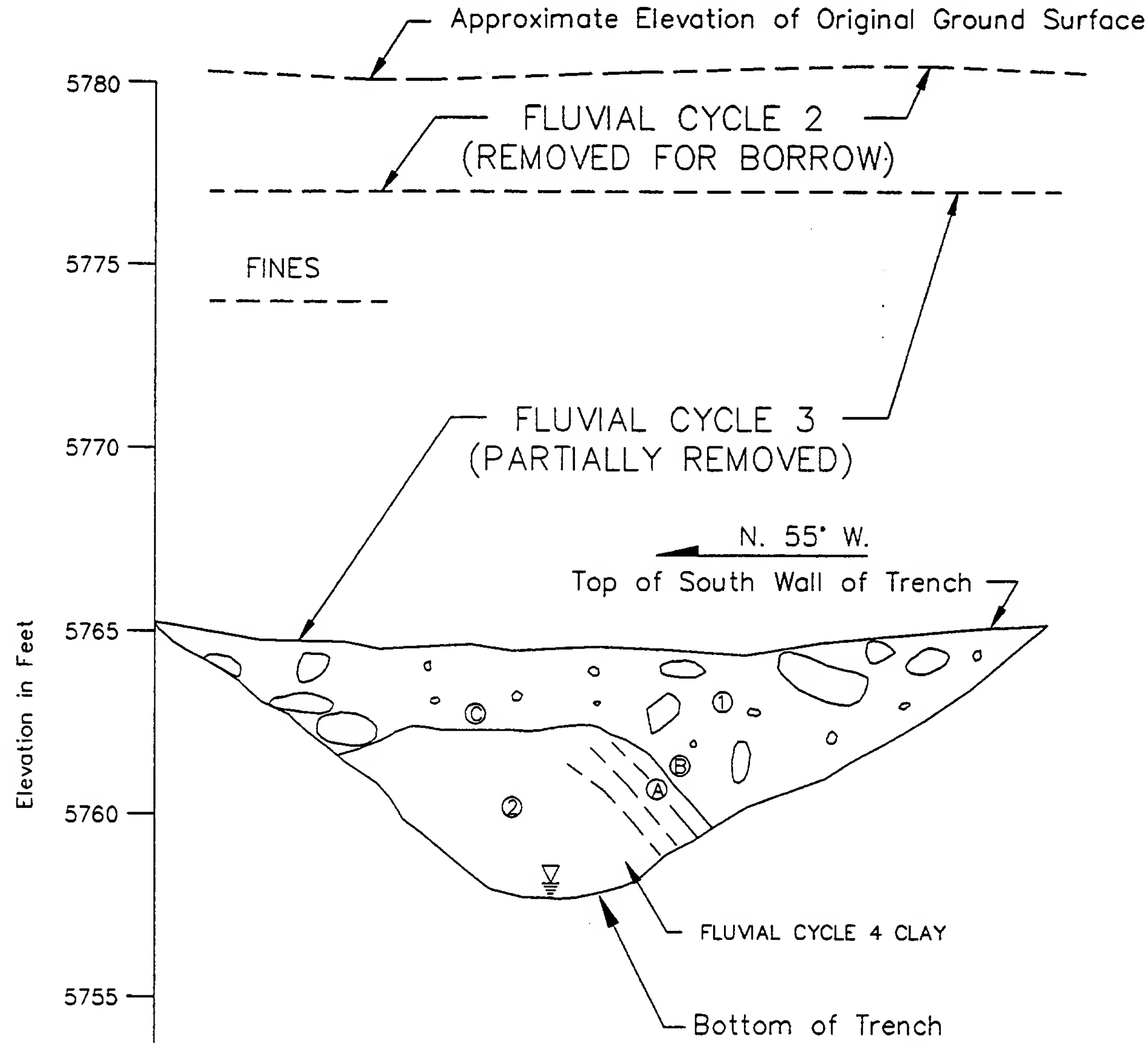
Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT – 19

Figure 20

Logged by: B.A. Bryant   Date: 9-21-92



DESCRIPTION

Alluvium

① Cobbly gravel, scattered small boulders to 24"–diameter, subrounded to rounded clasts, poorly sorted; matrix is silty sand, light brown (5YR, 6/4), dense, moist to saturated

② Sandy clay, pale orange brown, very firm, moist to wet, some shearing

③ Cobbly gravel

▽ Elevation of groundwater on 9–21–92

ATTITUDES (360° Compass)

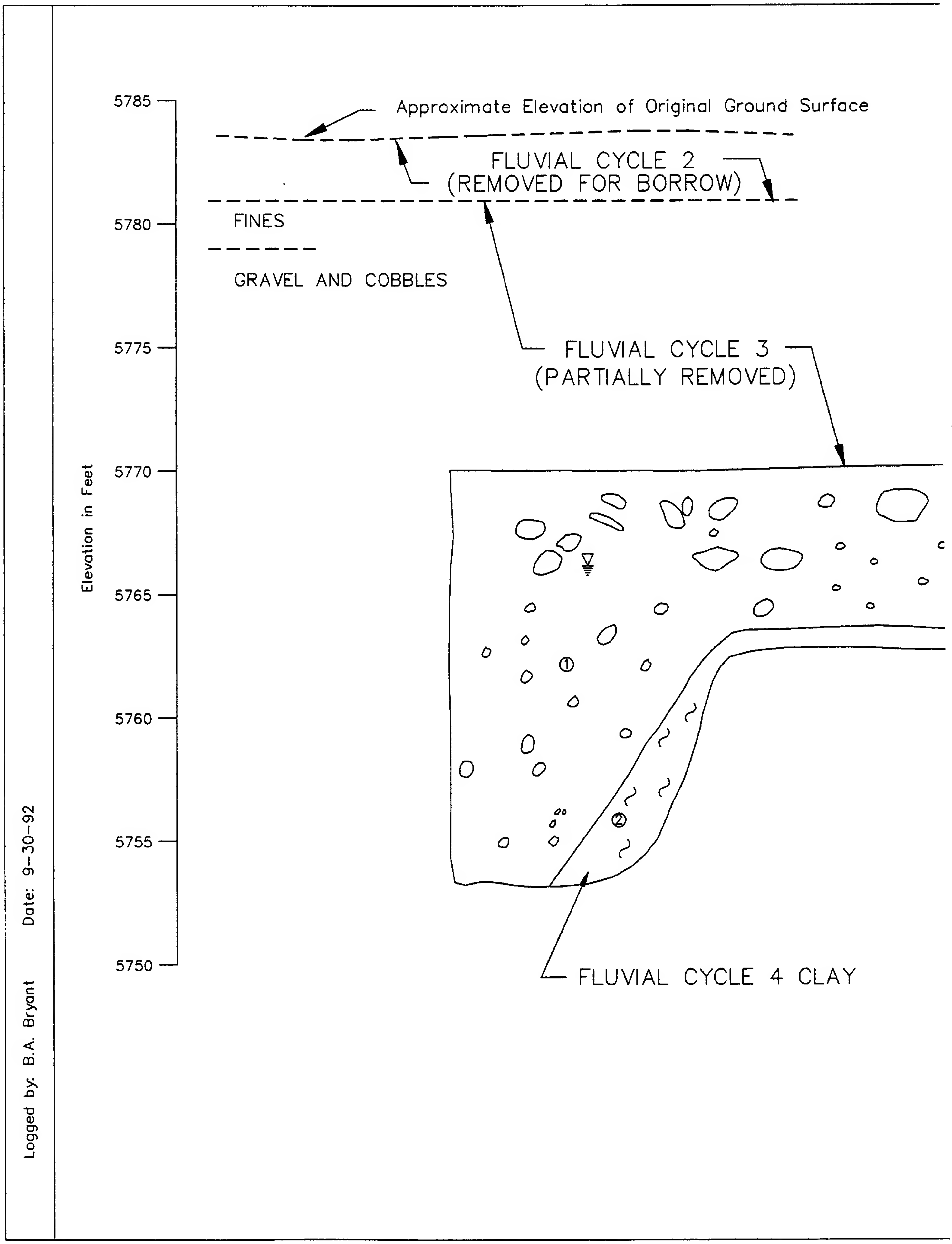
Ⓐ	22°, 44° W	Shear
Ⓑ	20°, 45° W	Contact
Ⓒ	Near horizontal	Contact/Bedding

Scale: 1"=5' 0 — 5 Feet

NOTE: Location shown on Figure 2

FT – 20

Figure 21


Approximate Elevation of Original Ground Surface
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
FINES
GRAVEL AND COBBLES
FLUVIAL CYCLE 3
(PARTIALLY REMOVED)
FLUVIAL CYCLE 4 CLAY
5785
5780
5775
5770
5765
5760
5755
5750
Elevation in Feet
Logged by: B.A. Bryant
Date: 9-30-92

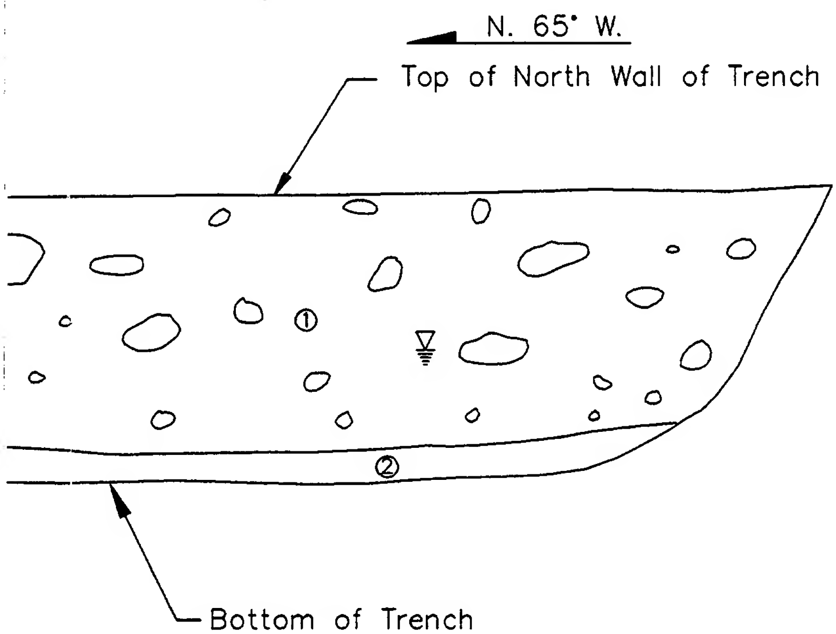
DESCRIPTION

Alluvium

① Cobbly gravel, scattered small boulders to 24"-diameter, subrounded to rounded last, poorly sorted; matrix silty sand, light brown (5YR, 6/4), dense, moist to saturated

② Sandy clay, pale orange brown, very firm, moist to saturated some shearing

∇ Elevation of groundwater 9-30-92

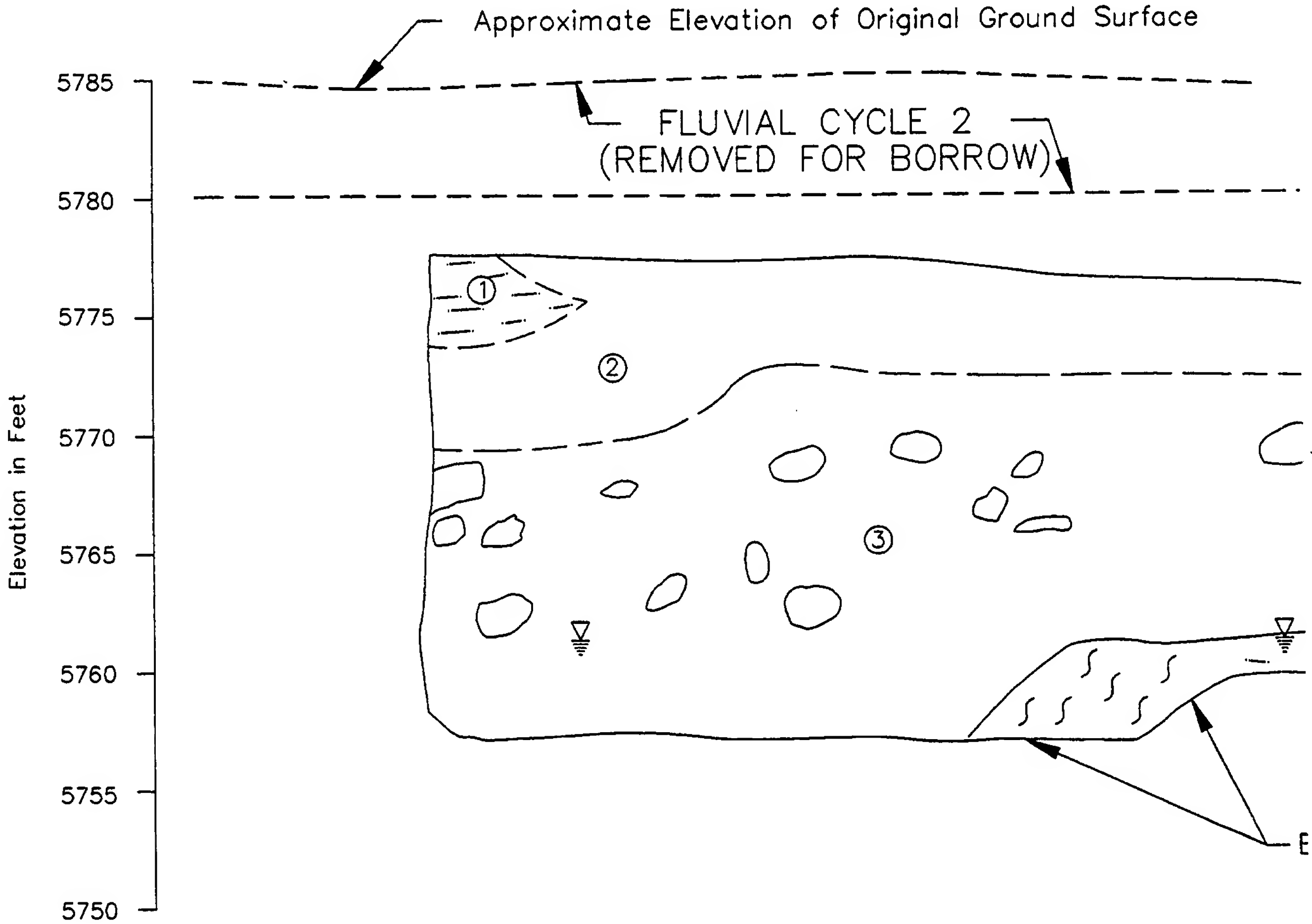


Scale: 1"=5' 0 5 Feet

NOTE: Location shown on Figure 2

FT - 21

Figure 22



DESCRIPTION

Alluvium

① Silty fine sand, red–brown, dense, friable, very moist to wet, s

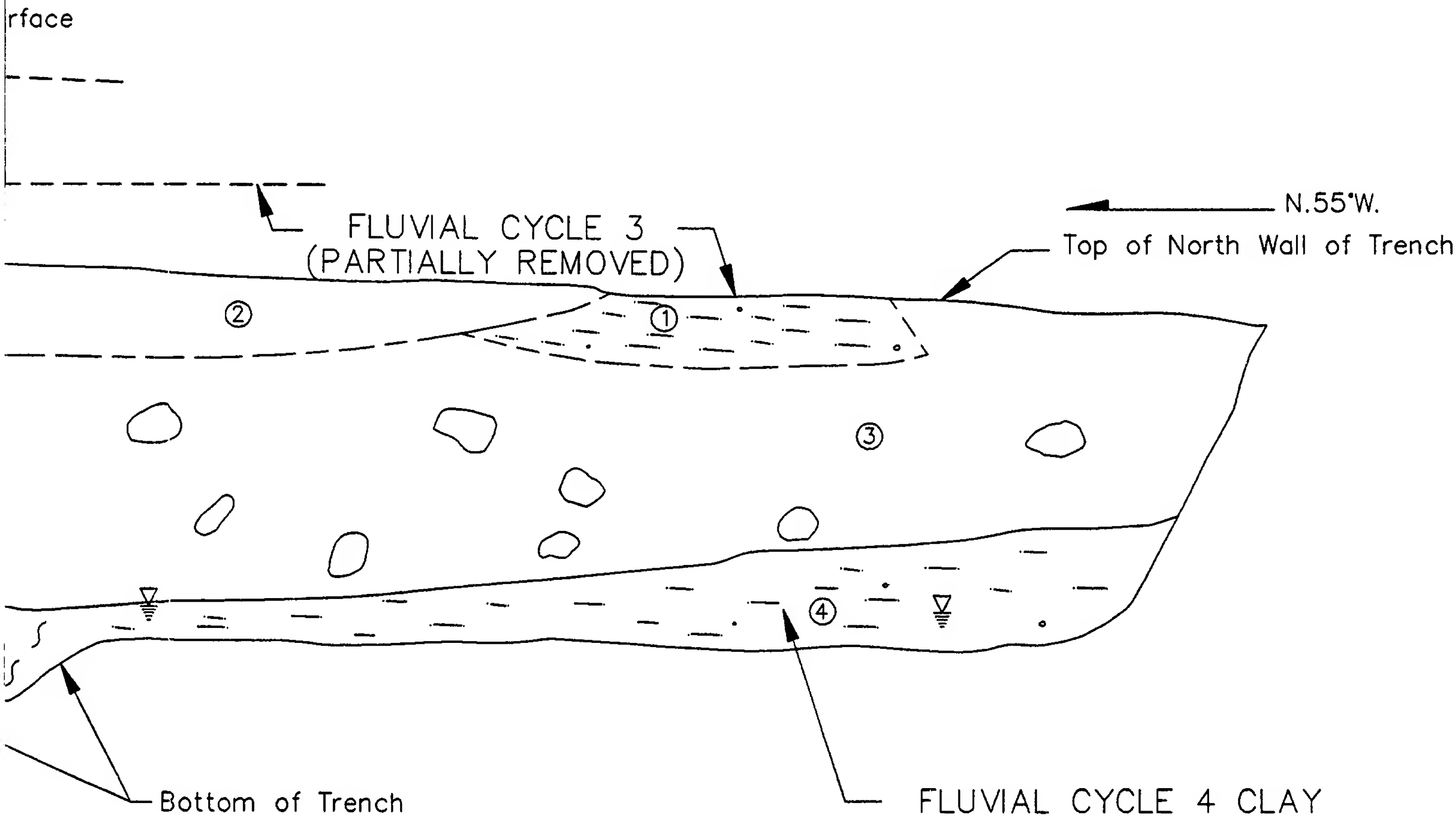
② Cobble conglomerate, moderately sorted, rounded to subrounde clast supported: matrix is silty sand, red–brown, dense

③ Cobble conglomerate, abundant boulders to 20"–diameter, poor rounded to subrounded clasts; matrix is silty sand, red–brown,

④ Sandy clay, red–brown, scattered gravel, some bedding, fine, w

⊽ Elevation of groundwater on 10/1/92

Logged by: B.A. Bryant Date: 10/1/92



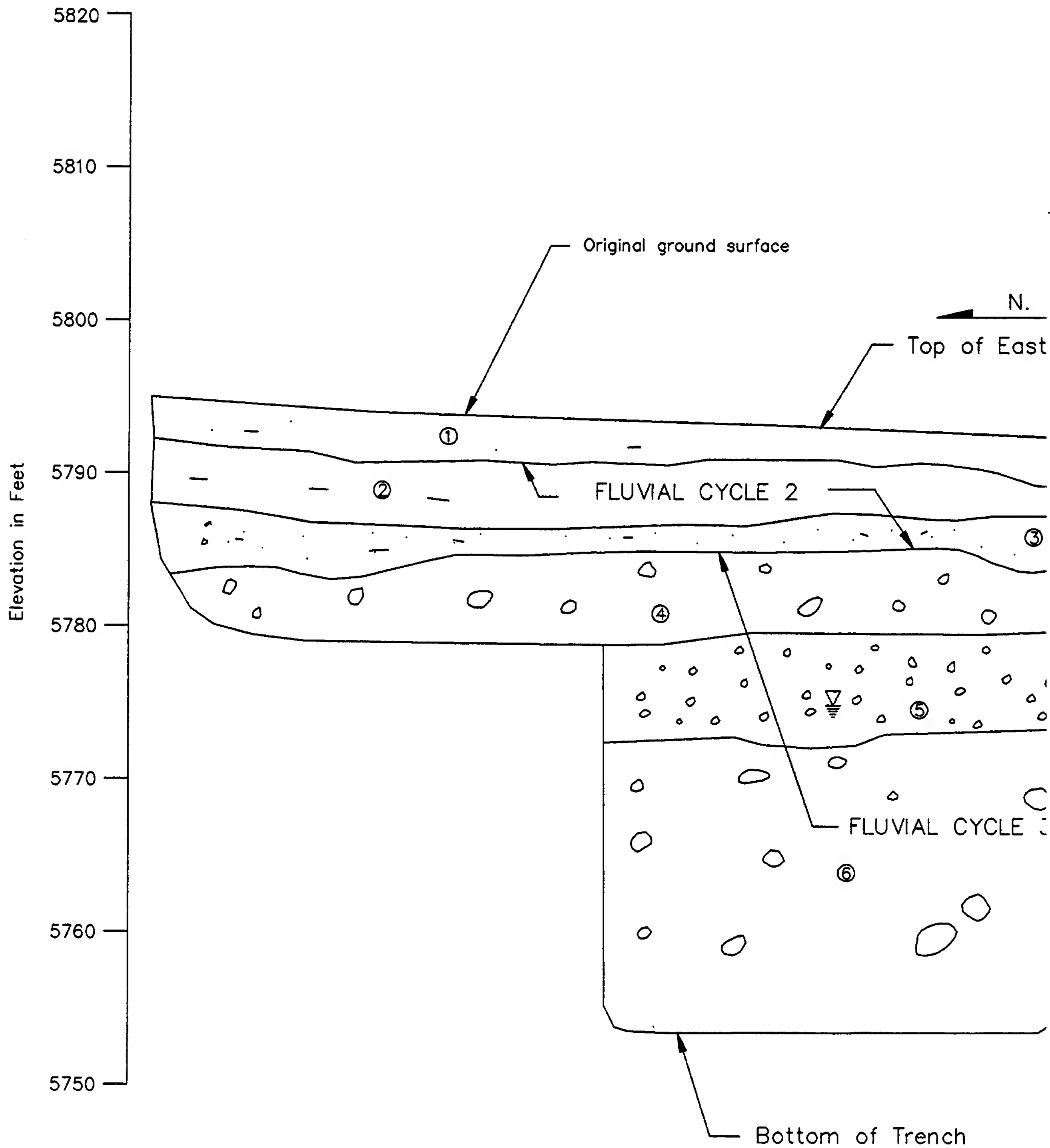
moist to wet, scattered gravel
ed to subrounded clasts,
n, dense
–diameter, poorly sorted,
and, red–brown, dense
bedding, fine, wet

Scale: 1"=8' 0 8 Feet

NOTE: Location shown on Figure 2

FT – 22

Figure 23



Logged by: B.A. Bryant Date: 9-21-92

N. 30° W.

of East Wall of Trench

DESCRIPTION

Topsoil

① Sandy silt, black (N1), loose, very porous, damp to wet, abundant roots and rootlets, scattered gravel

Alluvium

② Clayey silt, dark gray (N3), soft to moderately firm, moist; abundant roots and rootlets, moderately cemented horizon approximate 3"-thick near top of unit

③ Sandy clay, mottled yellowish brown (10YR, 5/4) and reddish brown (5YR, 4/4), stiff, moist, slightly porous, scattered subrounded gravel

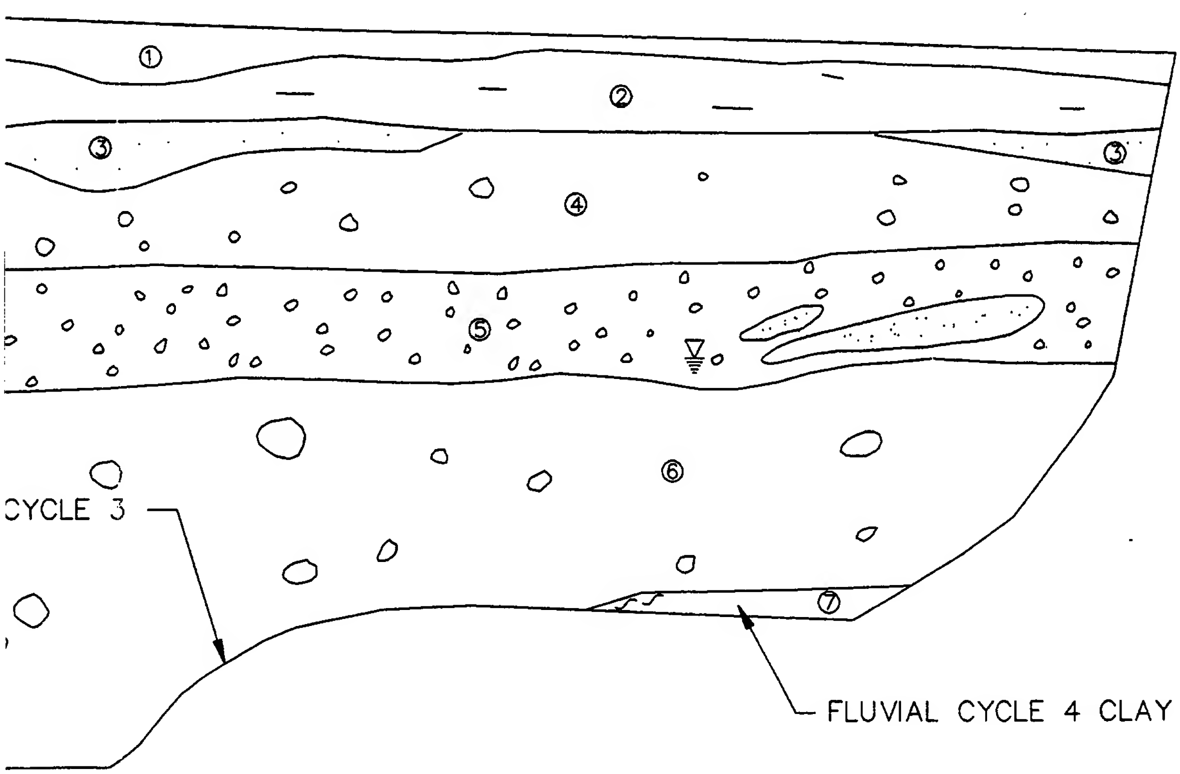
④ Cobbly gravel, scattered small boulders to 18"-diameter, clasts are rounded to subrounded, poorly sorted; matrix is clayey sand to silty sand, mottled dark reddish (5YR, 3/4), and very light gray (N8), dense, moist

⑤ Cobbly gravel, subrounded clasts, moderately sorted; matrix is silty fine sand, moderately reddish brown (10R, 4/6), dense, slighty friable; discontinuous sand lenses are present

⑥ Cobbly gravel, scattered, small boulders to 24"-diameter, rounded to subrounded clasts, poorly sorted; matrix is silty sand, light reddish brown (5YR, 6/4), dense, moist to saturated

⑦ Sandy clay, scattered small boulders to 24"-diameter, rounded to subrounded clasts, poorly sorted; matrix is silty sand, light reddish brown (5YR, 6/4), dense, moist to saturated

▽ Elevation of ground water on 9-21-92



Scale: 1"=10' 0 10 Feet

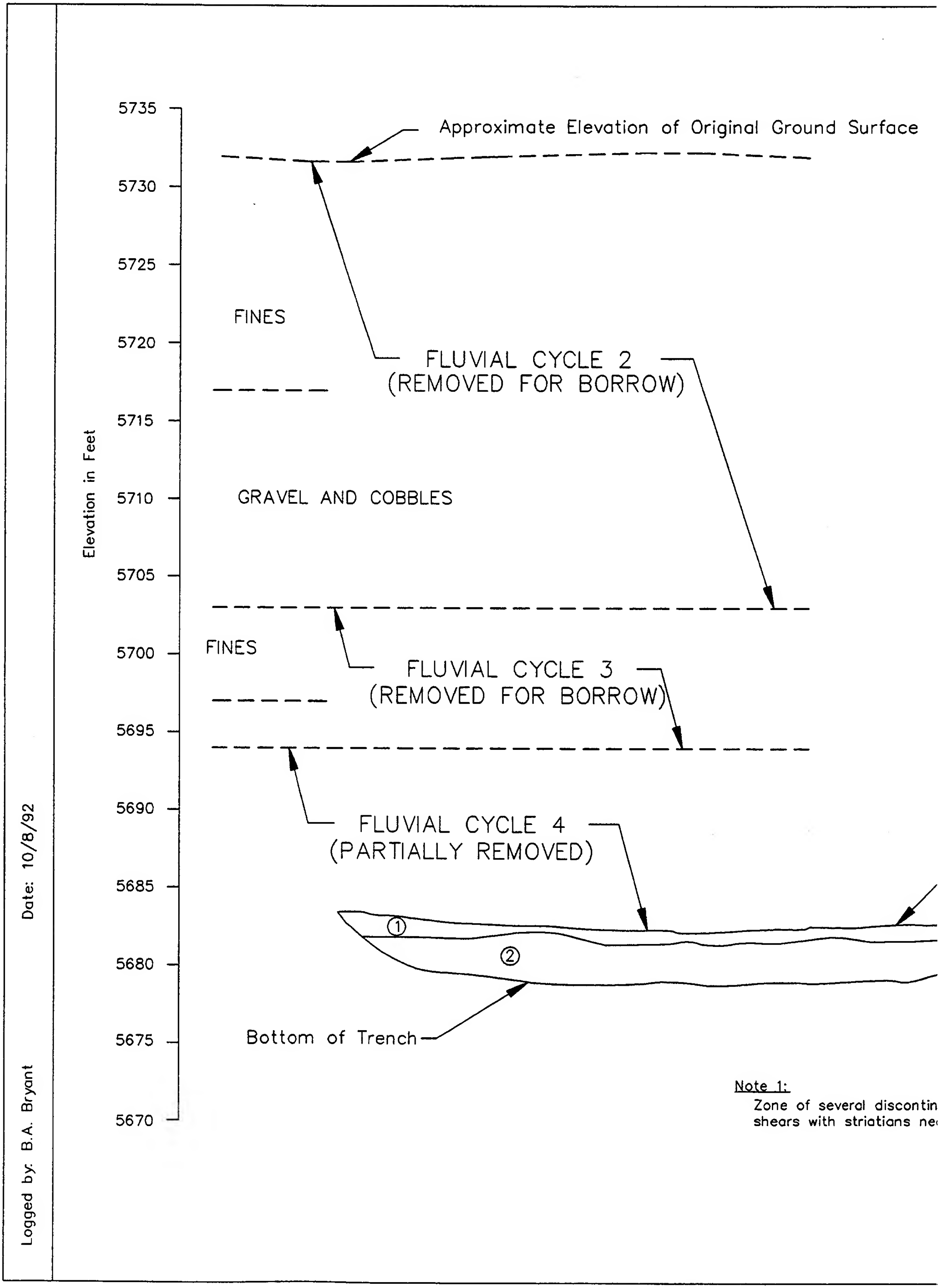
NOTE: Location shown on Figure 2

h

FT - 23

Figure 24

FT-24 NOT LOGGED


Logged by: B.A. Bryant
Date: 10/8/92
Elevation in Feet
5735
5730
5725
5720
5715
5710
5705
5700
5695
5690
5685
5680
5675
5670
Approximate Elevation of Original Ground Surface
FINES
FLUVIAL CYCLE 2
(REMOVED FOR BORROW)
GRAVEL AND COBBLES
FINES
FLUVIAL CYCLE 3
(REMOVED FOR BORROW)
FLUVIAL CYCLE 4
(PARTIALLY REMOVED)
1
2
Bottom of Trench
Note 1:
Zone of several discontin
shears with striations ne

face

DESCRIPTION

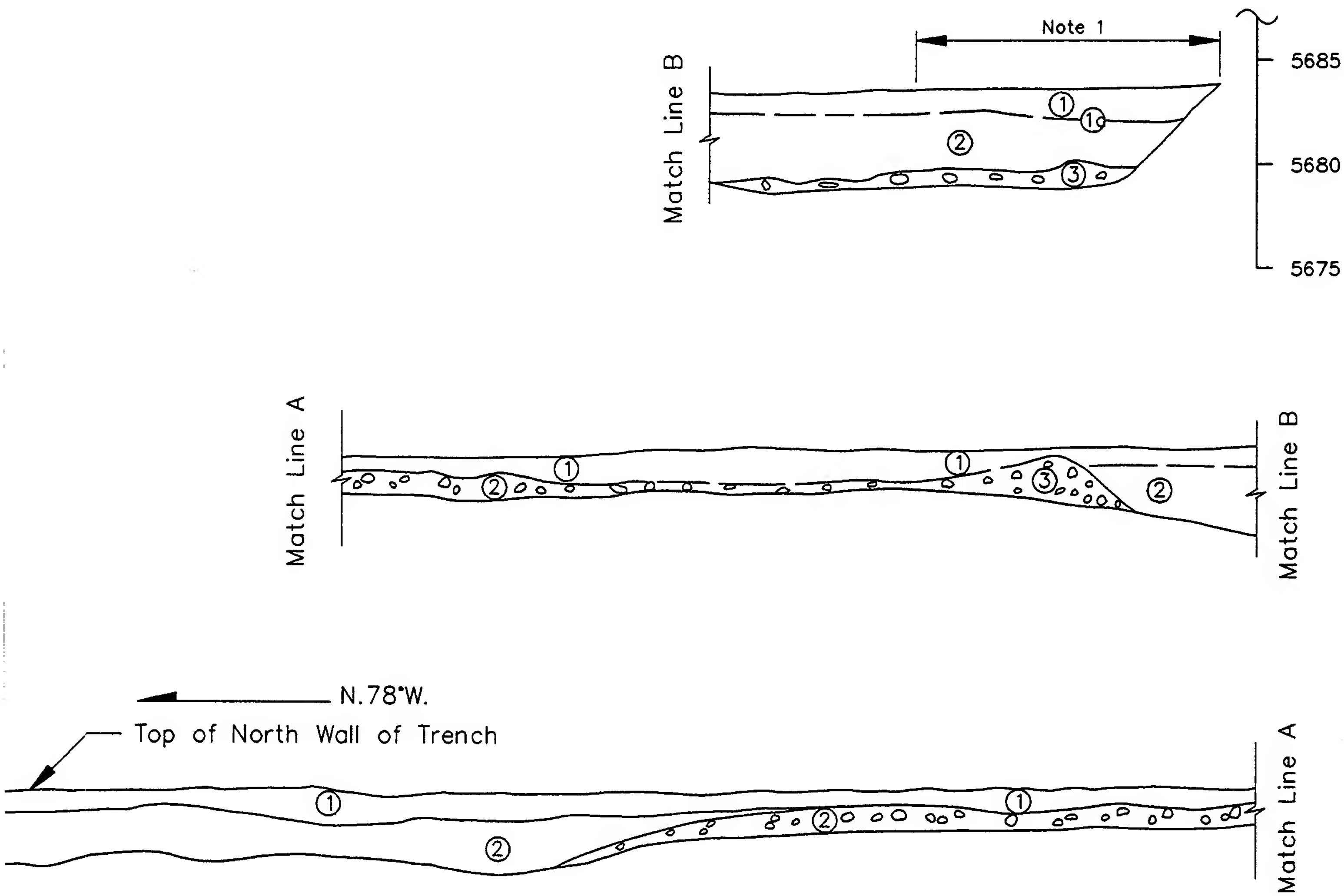
Alluvium

① Silty clay, moderate brown (5YR, 3/4), stiff to very stiff, moist, scattered calcium carbonate concretionary nodules, some apparent bedding

①a Clay (altered ash ?), discontinuous thin lens along bottom of ① up to 3" thick, pale olive gray, very stiff, very wet

② Silty fine sand, moderate red-brown (10R, 4/6), dense, moist, massive, moderately friable

③ Cobbly gravel, poorly sorted, rounded to subrounded clasts; matrix appears to be similar to ②



discontinuous, randomly oriented polished
tions near contact between ① and ②

Scale: 1"=8' 0 8 Feet

NOTE: Location shown on Figure 2

FT – 25

Figure 25

UTAH HISTORICAL SOC. TEL:801-364-6436 Sep 11,92 16:17 No.005 P.01

State of Utah
Department of Community & Economic Development
Division of State History
Utah State Historical Society

Norman H. Bangerter
Governor
Max J. Evans
Director

300 Rio Grande
Salt Lake City, Utah 84101-1182
(801) 533-5755
FAX: (801) 364-6436

MEMORANDUM

FAX 581-9786

TO: Carl Cole
FROM: David D. Gillette, State Paleontologist
DATE: September 11, 1992

RE: Quaternary fossils in the Little Dell Dam sediments

To date we have collected sediment samples from the lower and upper peat-clay zones from several sites within the disturbed area presently under construction. Fossil animals from these two levels include the bones of several large animals, the bones of a fair number of small animals, and several varieties of snails. Plants include abundant megaplant (stems, leaves, roots) remains, and quite likely a large species list to be derived from pollen samples. Our sediment samples and fossil samples are labeled according the the stratigraphic framework that you, Brian Bryant, and others have established and freely shared with us.

At present, we cannot list any identifications for plant, pollen, or snail remains. These will be critical for paleoenvironmental and paleobiogeographic reconstructions. Coupled with identifications of the vertebrates and with stratigraphic control provided by radiocarbon dates, these data will become a reference standard for study of (1) alluvial history of the valleys of the Wasatch Front, (2) tectonic history of the Wasatch Front, and (3) faunal and floral history of central Utah. In that respect, the fossil remains are unique and deserve considerable attention.

Positive identifications to species for all vertebrates remain to be determined. The following list established the identifications at the level of reasonable guesses:

Proboscidea
- Mastodon

Artiodactyla
- Large ungulate, in the size range of elk or moose, but not bison

Perissodactyla
- Extinct horse-- Equus sp., probably zebrine horse

Rodentia
- rodents from the subfamily Microtinae--extinct species

All of these fossils are consistent with a middle to late Pleistocene age (ranginf from roughly 1 million to 11,000 BP). We cannot provide any dates more precise than that estimate at present. I do not see any evidence of any date older than Pleistocene.

RCV BY:XEROX TELECOPIER 7011 ; 8-18-92 2:40PM ; 8015819786;# 2
UG-18-92 TUE 15:44 P.02

BETA ANALYTIC INC.

JERRY J. STIPP, PH.D.
MURRY A. TAMERS, PH.D.
CO-DIRECTORS

4985 S.W. 74 COURT
MIAMI, FLORIDA
33155 U.S.A.

REPORT OF RADIOCARBON DATING ANALYSES

FOR: Carl Cole
US Army Corp of Engineers

DATE RECEIVED: August 11, 1992
DATE REPORTED: August 18, 1992
SUBMITTER'S PURCHASE ORDER #

OUR LAB NUMBER	YOUR SAMPLE NUMBER	C-14 AGE YEARS B.P. ±1σ	
Beta-55236	Little Dell Dam Older Alluvium	Greater than 39000 BP	(sediment)

These dates are reported as RCYBP (radiocarbon years before 1950 A.D.). By international convention, the half-life of radiocarbon is taken as 5568 years and 95% of the activity of the National Bureau of Standards Oxalic Acid (original batch) used as the modern standard. The quoted errors are from the counting of the modern standard, background, and sample being analyzed. They represent one standard deviation statistics (68% probability), based on the random nature

BETA ANALYTIC INC.
(305) 667-5167
UNIVERSITY BRANCH
P.O. BOX 248113
CORAL GABLES, FLA. 33124

REPORT OF RADIOCARBON DATING ANALYSES

FOR: Carl Cole
U.S. Army Corps of Engineers

DATE RECEIVED: September 18, 1992
DATE REPORTED: September 24, 1992
SUBMITTER'S PURCHASE ORDER #

OUR LAB NUMBER	YOUR SAMPLE NUMBER	C-14 AGE YEARS B.P. ± 1σ	
Beta-56197	CS-2	37200 +/- 600 BP	(sediment)

Note: the sample was given extended counting time.

These dates are reported as RCYBP (radiocarbon years before 1950 A.D.). By international convention, the half-life of radiocarbon is taken as 5568 years and 95% of the activity of the National Bureau of Standards Oxalic Acid (original batch) used as the modern standard. The quoted errors are from the counting of the modern standard, background, and sample being analyzed. They represent one standard deviation statistics (68% probability), based on the random nature of the radioactive disintegration process. Also by international convention, no corrections are made for DeVries effect, reservoir effect, or isotope fractionation in nature, unless specifically noted above. Stable carbon ratios are measured on request and are calculated relative to the PDB-1 international standard; the adjusted ages are normalized to -25 per mil carbon 13.

APPENDIX B

ROY J. SHLEMON & ASSOC., INC.
Geological and Environmental Consultants

Post Office Box 3066
Newport Beach, California
92659 - 0620 U.S.A.
Tel: (714) 675 - 2696
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Quaternary Geology
Economic Geomorphology
Soil Stratigraphy
Geoarchaeology

APPENDIX B

ESTIMATED AGE OF LATE QUATERNARY FLUVIAL CHANNELS, RESERVOIR BORROW AREA, LITTLE DELL DAM, UTAH

by

Roy J. Shlemon

for

U.S. Army Corps of Engineers
Sacramento District

April 1993

CONTENTS

Page

INTRODUCTION. 1

BACKGROUND. 1

RESERVOIR AREA FAULTS 2

CHANNEL SYSTEMS 2

Fluvial Channel 1 3

Fluvial Channel 2 3

Fluvial Channel 3 4

Fluvial Channel 4 4

ESTIMATED AGE OF THE FLUVIAL CHANNEL SYSTEMS. 4

SUMMARY AND CONCLUSIONS 6

REFERENCES CITED. 7

APPENDIX B

ESTIMATED AGE OF LATE QUATERNARY FLUVIAL CHANNELS, RESERVOIR BORROW AREA, LITTLE DELL DAM, UTAH

INTRODUCTION

This Appendix briefly summarizes geological evidence and interpretations about the presence and estimated age of four Quaternary-age channels identified in the Reservoir area of Little Dell Dam in the western Wasatch Mountains, approximately 10 miles east of Salt Lake City. This study compliments the U.S. Army Corps of Engineers (CoE) investigation of potential surface fault rupture at and near the Little Dell Dam. The main purposes of this particular study are four-fold:

1. To review CoE trench logs and other geological data concerning the presence of datable stratigraphic markers at the site;

2. To evaluate CoE stratigraphic, radiocarbon, paleontologic, geomorphic and other dating techniques applicable to the fault investigation;

3. To critique draft CoE logs and reports; and

4. To summarize the late Quaternary fluvial stratigraphic history of the Little Dell Reservoir based on interpretation of CoE data.

BACKGROUND

This study was commissioned by the Sacramento District of the CoE. It is based mainly on site reconnaissance and discussions with CoE geotechnical personnel in the Little Dell and Sacramento offices; and on interpretations of CoE trench and boring logs, cross-sections, and pre-construction maps and photographs.

The conclusions of this study were previously reviewed with CoE personnel, but are here restated as more formal documentation. Pertinent trench logs, geologic and location maps, and various cross-sections are provided in the CoE narrative, and hence are referred to, but not replicated in this Appendix. Logistical support was kindly provided by CoE personnel; in particularly by C. Cole, T. Fea and R. Treat.

RESERVOIR AREA FAULTS

As summarized in the CoE narrative, three discrete "bedrock steps" were encountered during excavation of the Little Dell Dam and Reservoir. These steps, designated "A," "B," and "C," respectively, trend to the northeast, as observed in trenches (CoE Fig. 3). The steps coincide with shear zones and faults in the underlying Frontier Formation; and locally extend upward and deform the lower part of an overlying sequence of fluvial sediments. The recognition of these previously unknown faults led to the present CoE investigations of fault trend and relative activity.

Of particular interest is the age (time of last displacement) of the three Reservoir faults. If movement has taken place within the last 35,000 yrs, the faults would be considered "active" (capable) according to CoE criteria (see summary in CoE narrative). The time of last fault displacement is constrained by the age of the displaced and undisplaced Quaternary fluvial sediments formerly present in the Reservoir area. Accordingly, this stratigraphic analysis, combined with radiocarbon dates, provides an estimated age for the late Quaternary fluvial sediments within the Little Dell Reservoir.

CHANNEL SYSTEMS

Based mainly on bore hole and trench-log data, and on construction of both longitudinal- and cross-sections, the CoE has determined that four discrete fluvial channels once existed in the Little Dell Dam Reservoir area. Some gravels were observed during excavation of the dam foundation; others were clearly exposed during exploration of the borrow site.

A representative longitudinal section (CoE Fig. 9) and various cross sections (Figs. 10, 11 and 12), show that basal gravels of the four channels are regionally extensive, and are each covered by a fining-upward sequence of overbank sand and silts. Additionally, based on preconstruction photography and observations by CoE personnel, at least two of the ancient channel systems were expressed geomorphically by remnants of terraces, primarily on the north side of Mountain Dell Creek.

The four Little Dell Reservoir channels are informally designated FC-1 (youngest) through FC-4 (oldest). Fluvial channels 1, 2 and 3 extended far upstream beyond the approximately 6,000-ft long borrow area (CoE Figs. 5, 6 and 7). Locally, the basal gravels exceed 15-ft in thickness; and channel width was much greater than that of the modern floodplain. Prior to dam and reservoir excavation, the youngest two channel systems, FC-1 and FC-2, were expressed geomorphically as fluvial terraces, varying in

elevation from a few to about 30 ft, respectively, above the modern floodplain. The older channels, FC-3 and FC-4, are identified only in the subsurface, based on interpretation of CoE exploratory data (Figs. 7 and 8).

As elsewhere in Utah, the four Quaternary, Little Dell channel systems probably owe their origin to the advance and retreat of upstream mountain glaciers, particularly well documented by the periodic expansion and contraction of pluvial Lake Bonneville (Gilbert, 1890; Personius and Scott, 1992).

Fluvial Channel 1

Fluvial channel 1 underlies the present floodplain and extends upstream from Little Dell Dam at least 6,000 ft to the northeast end of the borrow area (CoE Fig. 5). The basal gravels are up to 15-ft thick; and channel width locally exceeds 500-ft. Based on exposures in the Little Dell embankment, the modern drainage is incised into the upper part of the FC-1 gravels. Some of the modern gravels are thus reworked from the underlying FC-1 gravels as well as from older, upstream terraces.

The areal extent of the FC-1 basal gravels, and the overlying fining-upward section indicate that deposition most likely took place under climatic conditions of the past when the Little Dell Dam drainage had greater hydraulic competence (extensive gravel deposition) than at present. With the following upstream deglaciation, extensive overbank sedimentation occurred downstream, giving rise to the grossly fining-upward, climatically-controlled deposits observed by the CoE in the Reservoir area. This change in hydraulic competence was regionally extensive, and hence most likely caused by the last major change of climate (glacial/pluvial epoch) in this part of Utah.

Fluvial Channel 2

Gravels underlying a regional geomorphic surface approximately 30 ft above the present Reservoir-area drainage form the base of Fluvial Channel 2. The FC-2 channel was also regionally extensive (CoE Fig. 6) and, prior to erosion by FC-1, was at least 1,000-ft wide upstream from the Little Dell embankment.

A CoE longitudinal section (Fig. 9) shows that FC-2 deposits generally thicken downstream toward the Little Dell Dam. Geomorphically, they were best preserved north of the modern drainage as a distinct fluvial terrace; to the south they have been truncated and deeply incised by the FC-1 deposits (CoE longitudinal

sections A-A' [Fig. 9] and cross section B-B' [Fig. 10]). The FC-2 deposits, comparable to other channels in the Reservoir area, also fine upward and are regionally extensive. They were thus likely similarly laid down during a time of major climatic and hydrological change in headwaters above Little Dell Dam. Based on stratigraphic position, this likely took place during the penultimate glacial/pluvial epoch in this part of Utah.

Fluvial Channel 3

Fluvial Channel 3 deposits are also areal extensive, at least 800-ft wide immediately upstream from Little Dell Dam and up to 50-ft thick (CoE Figs. 7, 9, and 10). As shown on a CoE cross-section (Fig. 10), FC-3 gravels are covered by younger FC-2 terrace sediments north of the present drainage, and truncated by the still younger FC-1 gravels to the south. As documented in the CoE narrative, Reservoir faults A, B, and C extend into and deform basal FC-3 gravels. Apparent displacement is generally less than about five feet. Significantly, however, overlying FC-3 fine-grained sediments are not offset. Therefore, last displacement of the Reservoir faults took place during FC-3 "gravel time." As the other fluvial channel systems, FC-3 likely owes its origin to regional hydrologic and sedimentologic changes, similarly associated with a major glacial/pluvial event.

Fluvial Channel 4

Fluvial Channel 4 is the least extensive of the four Little Dell Reservoir channels. As shown on a longitudinal section (CoE Fig. 8), the FC-4 deposits are mainly restricted to the upstream portion of the Reservoir. These sediments are clearly displaced, in some cases possibly tens of feet (Figs. 4 and 9). Based on regional extent, on the thickness of its apparently glacially-derived basal gravels, and on its fining-upward stratigraphy, FC-4 is likewise judged to have been laid down during an epoch of regional glaciation and pluviality.

ESTIMATED AGE OF THE FLUVIAL CHANNEL SYSTEMS

As estimated age for the four Little Dell fluvial channels is afforded by an inferred chronological association with the numerically-constrained marine oxygen-isotope stage events (see, for example, Shackleton and Opdyke, 1973; 1976). Although possibly locally correlative with the several glacial events identified in the Wasatch Mountains (summarized in U.S. Bureau Reclamation,

1988a), the Little Dell channels are here generally related to glacio-eustatic sea level fluctuations engendered by probable worldwide changes in climate. In brief, regionally-extensive glaciation typically resulted in greatly increased hydraulic competence of most high mountain, high-order streams. Extensive channel gravels were frequently deposited downstream, often well below the terminus of a particular glacial advance. The gravels were then usually covered by fining-upward overbank deposits laid down during the late glacial-interglacial transition. Sedimentation response time likely varied greatly from one drainage to another, owing to local climatic and hydrologic vagaries; and hence without locally-obtained numeric dates, channel-age estimates are inherently uncertain. On average, however, the isotope-stage chronology provides a reasonable estimate as to the likely age of regionally-extensive mountain glaciations. Accordingly, and conservatively assuming that there are no missing cycles in the Little Dell late Quaternary stratigraphy to imply even greater antiquity, then a minimum age for the four channels is deduced by association with the last four, oxygen-isotope dated glacio-eustatic lowstands of sea level. As summarized in CoE Table 1, the FC-1 (youngest) gravels well under the present floodplain are thus judged to be about 12,000 to 20,000 yrs old (isotope stage 2). The next stratigraphically older fluvial gravels, FC-2, are an estimated 60,000 to 70,000 yrs old (stage 4). FC-3 deposits are about 160,000 yrs old (stage 6); and FC-4 gravels are an inferred 250,000 to 300,000 yrs old (stage 8).

Regionally, the isotope-stage age estimates for the Reservoir channels is supported by the presence of similar-age, fluvial channel and terraces, likewise displaced, in an area about 11 miles northeast of the Little Dell Dam (U.S. Bureau Reclamation (1988b).

The Little Dell stratigraphic isotope-stage age assessment is also supported by two site-specific dates. The basal gravels of FC-4 yielded a finite age of greater than about 39,000 years (CoE Trench FT-5; Beta 55236); and the base of the undisplaced FC-3 fining-upward section provided an approximately 37,000-yr old date (cutbank exposure; Beta 56197). Contamination of the FC-3 sample is likely high, owing to the presence of abundant modern organic matter and high groundwater levels in this area. Nevertheless, the approximately 37,000-yr old radiocarbon date provides a minimum age for the upper part of the FC-3 sediments, and hence an independent numeric assessment as to the time of last fault displacement in the Reservoir area.

SUMMARY AND CONCLUSIONS

Three bedrock steps in the Little Dell Reservoir area coincide with shear zones and faults in the underlying Frontier Formation, and are informally designated as faults A, B, and C.These faults extend upward into and displace the oldest of the overlying Quaternary-age channel deposits (FC-4), and extend into the base of an upper deposit (FC-3). The age (time of last displacement) of the faults is constrained by the estimated ages for both displaced and overlying undisplaced channel deposits.

Four discrete channel systems are identified in the Little Dell Reservoir area, based mainly on interpretation of trench and boring data, on reconstruction of longitudinal profiles and cross-sections, and on CoE observations of pre-construction topography.

The youngest channel, FC-1, underlies the modern floodplain, is regionally extensive, and is judged to have been laid down during the last major regional change in climate and hydraulic competence. It age, deduced by association with the marine oxygen-isotope stage chronology, is about 12,000 to 20,000 yrs old (isotope stage 2).

Fluvial channel 2 underlies a geomorphic surface approximately 30-ft above the present Mountain Dell drainage. Its basal gravels are likewise regionally extensive and it, too, was probably deposited in response to regional climate and hydrologic change. Accordingly, it is estimated to be about 60,000 to 70,000 years old (stage 4).

The progressively older FC-3 and FC-4 deposits also fine-upward and are regionally extensive. Faults A, B, and C, clearly displace FC-4 deposits. The faults, however, terminate upward within the basal FC-3 gravels. Ages for the FC-3 and FC-4 deposits, deduced by association with the isotope stage chronology, are about 160,000 (stage 6) and 250,000 (stage 8) yrs, respectively.

A radiocarbon date of about 37,000 yrs provides an independent age for undisplaced FC-3 overbank deposits. However, contamination by modern groundwater is probable, and therefore the FC-3 sediments are likely much older, ostensibly somewhat in excess of about 100,000 yrs old, based on the inferred isotope-stage correlation. The finite 39,000 yr old date for displaced FC-4 gravels is consistent with an isotope-stage age estimate of about 250,000 years.

In sum, the isotope-stage estimated age of the four Little Dell channel systems, coupled with two site radiocarbon dates, indicate that last displacement of Little Dell Reservoir faults A, B, and C took place prior to about 37,000 years ago, and more likely at least 100,000 yrs ago.

REFERENCES CITED

Gilbert, G. K., 1890, Lake Bonneville: U.S. Geological survey Monograph 1, 438 p.

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U.S. Bureau of Reclamation, 1988a, Central Utah regional seismotectonic study for USBR dams in the Wasatch Mountains: U.S. Bureau Reclamation Seismotectonic Rept. 88-5, USBR Seismotectonic Section, Denver, Colorado, 269 p., attachments.

_____, 1988b, Seismotectonic study for Jordanelle Dam and Reservoir site, Central Utah Project, Utah: U.S. Bureau Reclamation Seismotectonic Rept. 88-6; USBR Seismotectonic Section, Denver, Colorado, 73 p., attachments.

APPENDIX 2

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

February 25, 1993

Geotechnical Branch

Mr. Robert L. Morgan, State Engineer
Department of Natural Resources
Division of Water Rights
1636 West North Temple, Suite 220
Salt Lake City, Utah 84116-3156

Dear Mr. Morgan:

The purpose of this letter is to provide an interim response to satisfy the State of Utah requirements for safety certification of Little Dell Dam in order to facilitate the turnover process from the Corps of Engineers to the local sponsors and the initiation of reservoir filling. Please reference your letter dated October 28, 1992 (enclosure 1), and a telephone conversation record dated December 4, 1992 (enclosure 2). A summary of geologic issues (enclosure 3) is provided specifically to address those geologic issues in requirement number 5 on page 2 of enclosure 1 regarding conditions to be met prior to reservoir filling. These issues are: current findings on the fault in the reservoir borrow area; the inferred fault shown through the dam foundation on the U.S. Geological Survey map by Bryant (Map I-1944, dated 1990); and the potential for new data on faults to change the design earthquake for the dam. The final report covering these issues is expected to be completed by late March or April 1993.

We believe that no faults in, through or near the dam foundation are to be considered as capable faults and, therefore, the dam is seismically safe for certification by the State of Utah. Also, we see no reason to delay the scheduled turnover process to local sponsors or the initiation of reservoir filling. A copy of the final report on the geologic structure study and age-dating of faults will be provided to you upon completion.

Sincerely,

Lewis A. Whitney
Chief, Engineering Division

Enclosures

Copies Furnished (with/enclosures):

Dee C. Hanson, Executive Director, Department of Natural Resources, Division of Water Right, Salt Lake City, UT
Nick P. Sefakis, General Manager, Metropolitan Water District, Salt Lake City, UT
Neil D. Stack, Division Director, Salt Lake County Public Works Department, Engineering Division, Salt Lake City, UT
E. Tim Doxey, Deputy Director, Salt Lake City Department of Public Utilities, Salt Lake City, UT
Paul Parsoneault, Resident Engineer, Little Dell Resident Office, Salt Lake City, UT
CESPD-ED-G (Parrillo)
CESPD-PM (Ueda)

cc: PPMD
Engr Div (2)
Civ Proj Br
Civ Proj Sec B
Geotech Br
✓Geol Sec

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS October 28, 1992

Norman H. Bangerter
Governor
Dee C. Hansen
Executive Director
Robert L. Morgan
State Engineer

1636 West North Temple, Suite 220
Salt Lake City, Utah 84116-3156
801-538-7240

Arthur Walz
U S Army Corps of Engineers
20 Massachusetts Avenue NW
Washington DC 20134

RE: Little Dell Dam
Salt Lake City, Utah

Gentlemen:

As you are aware, David Marble of our Dam Safety Section participated with the US Army Corps of Engineers (COE) Periodic Inspection #1 (topping out) of the above referenced project October 20 - 22, 1992.

Prior to the initiation of construction activities on this project and in accordance with Utah State Law at that time, this office reviewed and approved the construction documents. In 1990, however, new legislation was passed that exempted dams owned by the COE from regulation by this office. The intent of the law, and our interpretation, is that the term "owned" is applicable to dams designed, constructed, inspected, and regulated by the COE, while actual ownership and operation is not necessary. In response to this law and our understanding that the COE future involvement in the dam would be consistent with that described above, this office took the position of an observer during construction.

During the periodic inspection last week, it was clearly indicated by yourself and others at the inspection, that the COE intends to remove itself from direct regulation of the dam to that of an advisor and reviewer. We understand that your contract with the local sponsor gives to the COE the right to regulate the operation of the structure; however, this right is only intended to be exercised during extreme conditions, and that it is the intent of the COE to assume the role of a consultant following transfer of the project to the local sponsors. Under these circumstances, it is our position that the COE involvement does not meet the intent of the Utah State Law for exemption and, as such, Little Dell Dam will not be exempt from regulation by this office.

Since this dam falls under a non-exempt category, we intend to begin regulatory activities with this structure immediately. In fact, this office should have participated in this role throughout construction activities. Given the abilities of your organization, however, we feel it is appropriate to rely on the technical expertise of the COE during this process. In the future, however, all decisions, revisions, improvements, modifications, etc. before or after transfer, should only be made with the prior approval of this office.

Enclosure 1

Prior to any filling of the reservoir, the following conditions must be met:

1. Summaries of all quality control and instrumentation readings should be forwarded to this office. In addition, all documents related to construction including, but not limited to, inspection journals and reports, tests results, change order documentation, instrumentation readings, etc. must be available for review by this office upon request. Access to documentation related to financial claims are not necessary; however, documents related to the technical issues of the claims should be available.

2. An Initial Filling Plan must be approved.

3. An Emergency Action Plan must be approved.

4. A Standard Operating Plan must be approved.

5. A report detailing your findings on the fault in the reservoir basin and the fault mapped by Bryant should be submitted to this office. We are concerned about the effects of a fault through the dam foundation as well as the potential of these faults to alter the design earthquake for the dam.

6. A written response from the COE that our understanding of your future participation is accurate and that the COE accepts the Utah State Engineer's Office as the lead regulatory agency for this project. The advice and recommendations from the COE will be helpful and welcome by this office.

In addition to the above, the following will also need to be completed:

1. A reproducible copy of the "As-Constructed" drawings will need to be provided to this office.

2. This office should be notified of and participate in the remaining inspections during and after initial filling to be conducted by the COE.

If you have any questions, or if you would like to discuss this project further, please call David Marble or Richard Hall of our Dam Safety Section.

Sincerely,

Robert L. Morgan

Robert L. Morgan, P.E.
State Engineer

RLM/rbh/dkm/sh

pc: Dee C. Hansen - Executive Director, Department of Natural Resources
Dan Parrillo
Clark Stanage
Bill Heyenbruch
Paul Parsoneault
Larry Johnson

CONVERSATION RECORD

TIME: 1205 Hrs

DATE: 4 Dec 92

TYPE: ☐ VISIT ☐ CONFERENCE ☒ TELEPHONE ☐ INCOMING ☒ OUTGOING

Location of Visit/Conference:

ROUTING	
NAME/SYMBOL	INT

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU: Mr. David Marble

ORGANIZATION (Office, dept., bureau, etc.): Utah Dept. of Nat. Resources, Div. of Water Rights, Dam Safety Sec.

TELEPHONE NO: (801) 538-7240

SUBJECT: Little Dell Dam, Geologic Structure Study

SUMMARY

The study was discussed with Mr. Marble and he was informed that to-date we have seen no evidence of faulting younger than 37,200±600 years (radiocardon date), and the results of our on-going soil-stratigraphic correlation and the final evaluation by our Quaternary geologic Specialist - to be completed about Mar or Apr 93 - could indicate the age of faulting to be up to 100,000 years or older. Also, we do not agree with Bruce Bryant's interpretation (USGS Map I-1944, dated 1990) which shows an inferred fault through the damsite.

Mr. Marble stated that the State Dam Safety Section was not too concerned with structures (or faults) noted in the reservoir or dam foundation areas, rather with a capable fault that might exist close to the dam that could raise values previously considered for the MCE. Bryant's fault probably isn't a concern.

When asked, Mr. Marble agreed that an interim letter from the Corps, stating results of the study to-date, would satisfy the State's requirements for dam certification so as not to hold up the turnover process to local sponsors or the reservoir filling plan. He requested a copy of the final report to ensure there was no disagreement with the interim letter and to see if additional investigations were required.

ACTION REQUIRED

Provide an interim letter to the State of Utah, Dam Safety Section

NAME OF PERSON DOCUMENTING CONVERSATION: ROBERT L. TREAT, Chief, Geology Section

SIGNATURE: Robert L. Treat

DATE: 10 Dec 92

ACTION TAKEN

Completed letter to the State of Utah on 17 Feb 93

SIGNATURE: Robert L. Treat

TITLE: Chief, Geology Section

DATE: 17 Feb 93

Enclosure 2

CESPK-ED-GG February 25, 1993

SUMMARY OF GEOLOGIC ISSUES - LITTLE DELL DAM, UTAH

This summary addresses three main geologic issues of concern regarding Little Dell Dam, Utah for the purposes of safety certification, the turnover process from the Corps of Engineers to the local sponsors and initiation of reservoir filling. These issues are discussed separately below.

GEOLOGIC STRUCTURE STUDY

Two separate work efforts are involved in the geologic structure study. The first, from June through October 1992 was accomplished by our project geology staff at Little Dell Dam. They investigated "steps" found in the Frontier Formation bedrock during the Contractor's reservoir borrow area excavations. These bedrock steps were found to be associated with bedding plane faults having apparent reverse sense of movement that appears to have displaced bedrock up over alluvial materials. In this part of the study numerous backhoe trenches were excavated and geologically logged. Carbonaceous zones found in peat-clay layers in some of the trenches were sampled and radiometrically age-dated by the carbon-14 method to be from 37,200±600 years to more than 39,000 years old. These peat-clay layers were probably subject to groundwater contamination which would affect the carbon-14 dating process resulting in error of dates younger than would otherwise be obtained. Also, Quaternary age fossils were found and were estimated to be of middle to late Pleistocene age ranging from about 1-million to 11,000 years old. Based on the trench explorations, general stratigraphic studies, and the minimal carbon-14 age-dates obtained, no evidence was found that faulting had occurred in the vicinity of the dam within the last 37,200±600 years before the present.

It was apparent that much additional work had to be performed in the reservoir area to address the stratigraphic position and relative geologic age of alluvium encountered in the trench study in order to determine the age of the latest faulting for the area. This work was undertaken by Sacramento District office geology staff in November 1992 with the assistance of Mr. Roy J. Shlemon, PhD., a noted Specialist in Quaternary geology . A considerable amount of soil-stratigraphic correlation work was done utilizing preconstruction and construction exploration data, and geologic mapping in the dam foundation area. Four cycles of fluvial channel deposition were recognized in the reservoir area and relative geologic ages are proposed for them consistent with their stratigraphic position, and state-of-the-art marine isotope stage chronology assessment by our Specialist. Based on preliminary stratigraphic age relationships developed for this

Enclosure 3

study only the oldest of the four fluvial channel deposits appears to have been displaced by bedding plane faults studied. This suggests that a more reasonable assessment of the latest fault movement may be about 100,000 years ago but possibly more than 200,000 years ago in late Quaternary time. This conclusion fits well with reported U.S. Bureau of Reclamation (USBR) data from adjacent areas and supports the assessment that the faults are not capable by Corps of Engineers criteria.

USGS GEOLOGIC MAP, 1990

During the first part of the geologic structure study a literature search for additional geologic information resulted in finding a recent regional geologic map by Bruce Bryant of the U.S. Geological Survey (USGS) in 1990 which covers the project area. A portion of this geologic map is included at the end of this summary. On this map the basic geology of the damsite area is largely unchanged from preconstruction data; however, significant changes were made in the location and extent of faults shown. For instance, on previous maps, the Little Mountain fault was a single trace located about 3/4-mile northwest of the dam. On the newer map, several fault splays are shown along the Little Mountain fault (referred to hereinafter as a zone), and one splay projects southward to within 1/2-mile of the dam. The trace of this splay may follow a deep gully and pass through the Little Dell Dam foundation in a highly weathered and sheared rock zone at dam axis Station 21+40. In that area Quaternary fluvial channel deposits overlying bedrock were not displaced. This 1990 map was discussed with appropriately qualified USBR personnel and they believe that there has been no Quaternary activity on the Little Mountain fault zone.

In addition to the fault splay noted above, an inferred (dotted) fault is shown on the 1990 USGS map that traverses the damsite in a northeasterly direction (about N. 65°E.) and follows Mountain Dell Canyon northward to the Little Mountain fault zone. Mr. Bryant was contacted about his map and was asked what evidence the fault was based on and, if it exists, how old would he judge it to be. He stated that one of the reasons he inferred this fault through the damsite was because he interpreted that the Frontier Formation was "cut-off" at the creek bed and he could not find evidence of it on the west side across the valley. His other reason was to explain what he interpreted as differential offset of the Paleocene-Eocene age Wasatch Conglomerate (±35 million years old) about 1 to 2 miles upstream from the dam across Mountain Dell Canyon. Regarding how old the fault could be, he stated that he never considered it could be geologically young, only younger than the Wasatch Conglomerate he

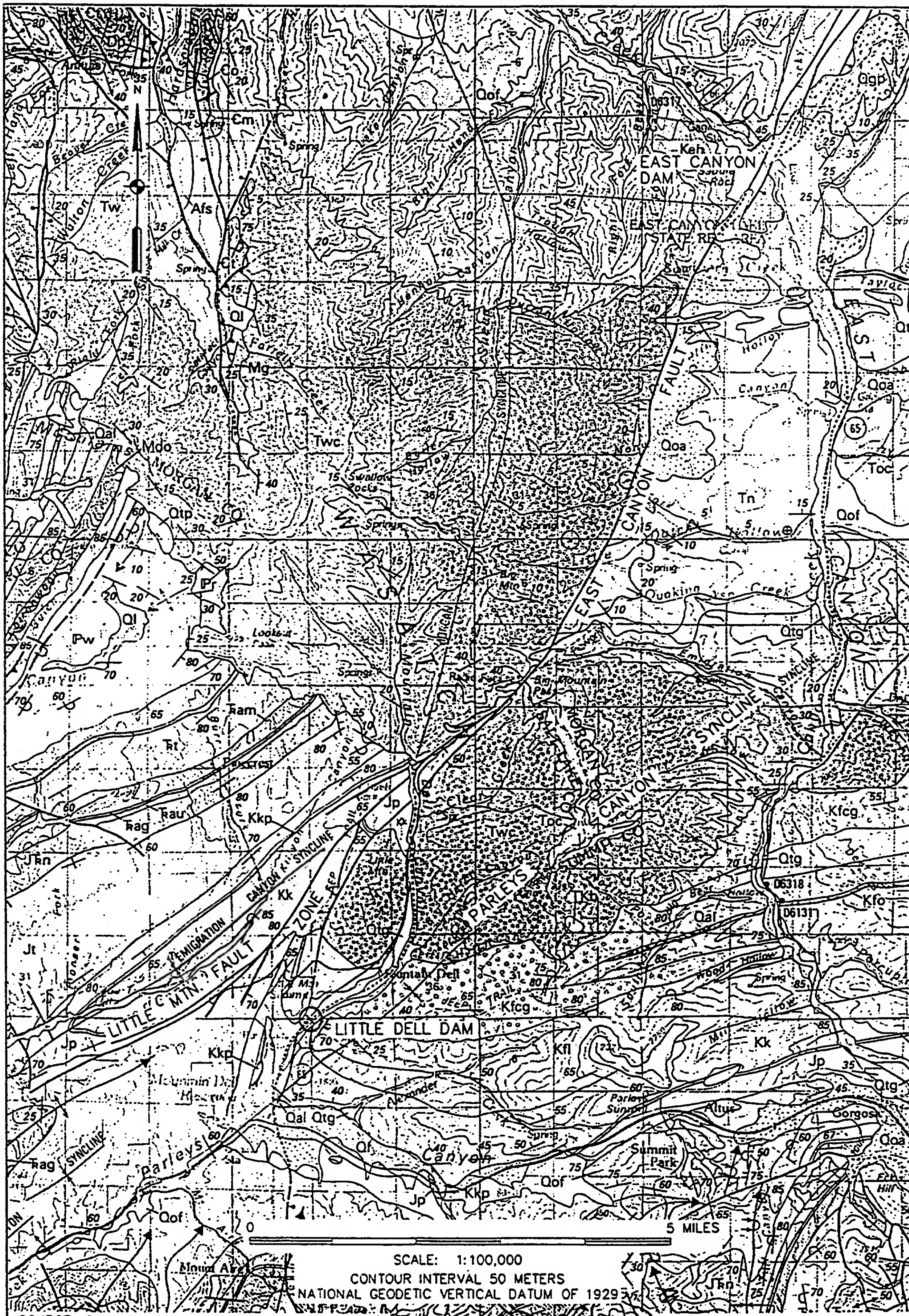
believes it offsets. He suspects late Tertiary to Quaternary movement because of the large graben structure to the northeast.

Numerous bedding plane faults, striking N. 23° to 26°E., were documented in the Little Dell Dam foundation but the inferred fault could not be identified. No major fault offset was seen in the Kelvin-Frontier Formation contact through the dam foundation and no through-going northeast-trending faults were encountered. Also, many of the trenches excavated in the reservoir borrow area for the structure study encountered the Frontier Formation bedrock at some depth beneath the Quaternary alluvial deposits. Therefore, we do not believe this inferred fault exists as shown, although it could possibly be continuous northward with the fault splay that may project through the dam foundation at Station 21+40. The suspected offset in the Wasatch Conglomerate could just as well be explained by another fault splay projecting part way down the canyon from the Little Mountain fault zone.

DESIGN EARTHQUAKE

The maximum credible earthquake (MCE) considered for construction of Little Dell Dam was determined by Dr. Bruce A. Bolt in 1986 as a Magnitude 7.25 earthquake located about 8 miles (13 km) west of the damsite on the Wasatch fault zone. This MCE value is not expected to change because no other active or capable faults have been identified in the vicinity of the dam.

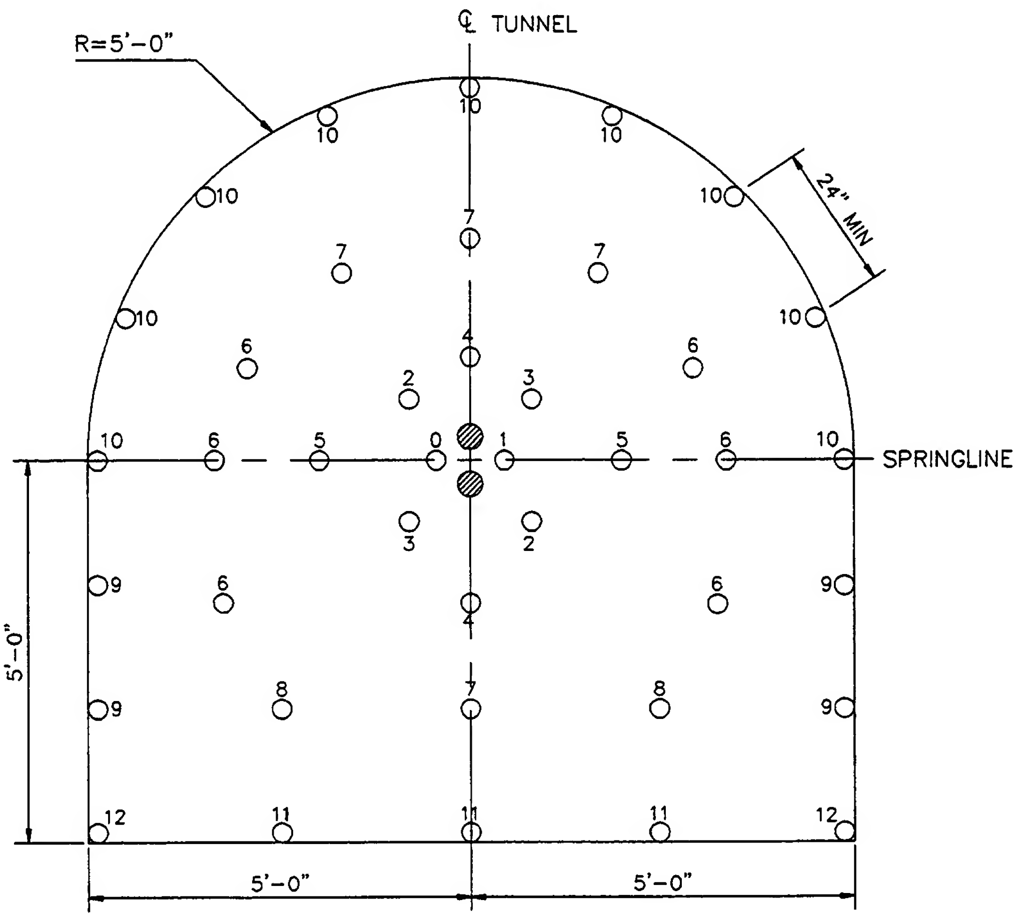
SACRAMENTO DISTRICT
CORPS OF ENGINEERS



SOURCE: Geologic Map of the Salt Lake City 30'x60' Quadrangle, North-Central Utah, and Unita County, Wyoming, USGS Miscellaneous Investigation Series Map I-1944, Bruce Bryant, 1990

GEOLOGIC MAP

LOAD: 40 – 1 3/4" HOLES x 10 FT. LONG
UNLOAD: 2 – 2 1/2" HOLES x 10 FT. LONG



LOAD #10 DELAY WITH HERCOSPLIT
7/8" x 24" TRIM POWER
8' LONG x 0.25#/LF = 18#

LOAD BALANCE OF HOLES WITH UNIGEL OR GELMAX
1 1/4" x 16", 4 STICKS PER HOLE
31 HOLES x 4 STICKS x 0.91#/STICK = 113#

TOTAL POWER PER ROUND 131#

VOLUME = 3.31 CY/LF x 10 LF = 33.1 CY
POWDER FACTOR = 131#/33.1 CY = 3.96#/CY

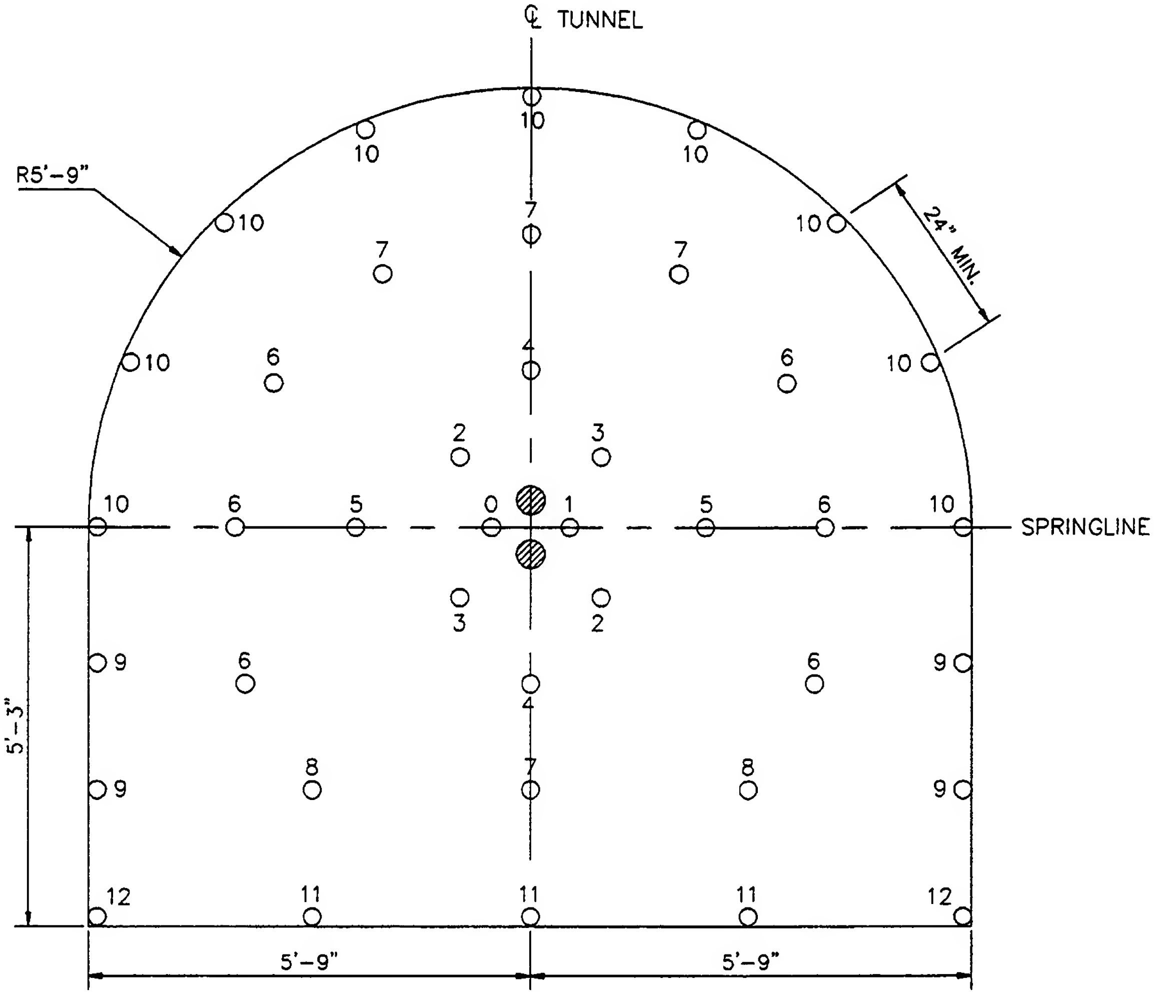
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

UPSTREAM TUNNEL

TYPICAL BLAST
HOLE PATTERN

Figure 1

DRILL: 42 HOLES x 10 FT. LONG
LOAD: 40 HOLES x 10 FT. LONG



EXPLOSIVES:

CHARGE #10 DELAYS WITH HERCOSPLIT OR SIMILAR TRIM
POWER 7/8" x 24" @ 0.25#/LF
9 HOLES x 8' LONG x 0.25#/LF = 18#

CHARGE INTERIOR HOLES WITH UNIGEL OR GELMAX
1 1/4" x 16", 5 STICKS PER HOLE @ 0.91#/STICK
31 HOLES x 5 STICKS/HOLE x 0.91#/STICK = 141#

TOTAL 159#

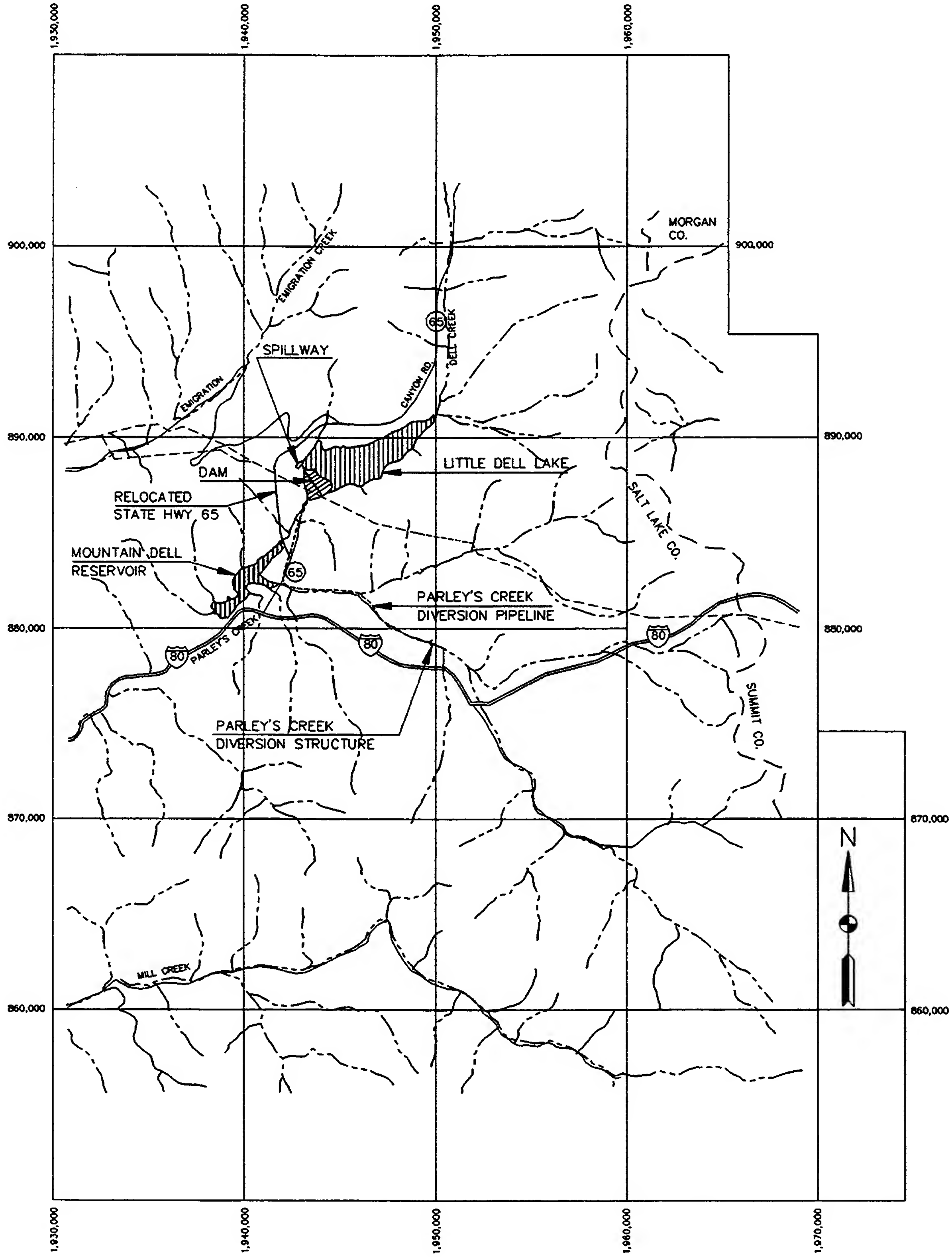
VOLUME = 4.16 CY/LF x 10 LF = 41.6 CY
POWDER FACTOR = 159#/41.6 CY = 3.82#/CY

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

DOWNSTREAM TUNNEL

TYPICAL BLAST
HOLE PATTERN

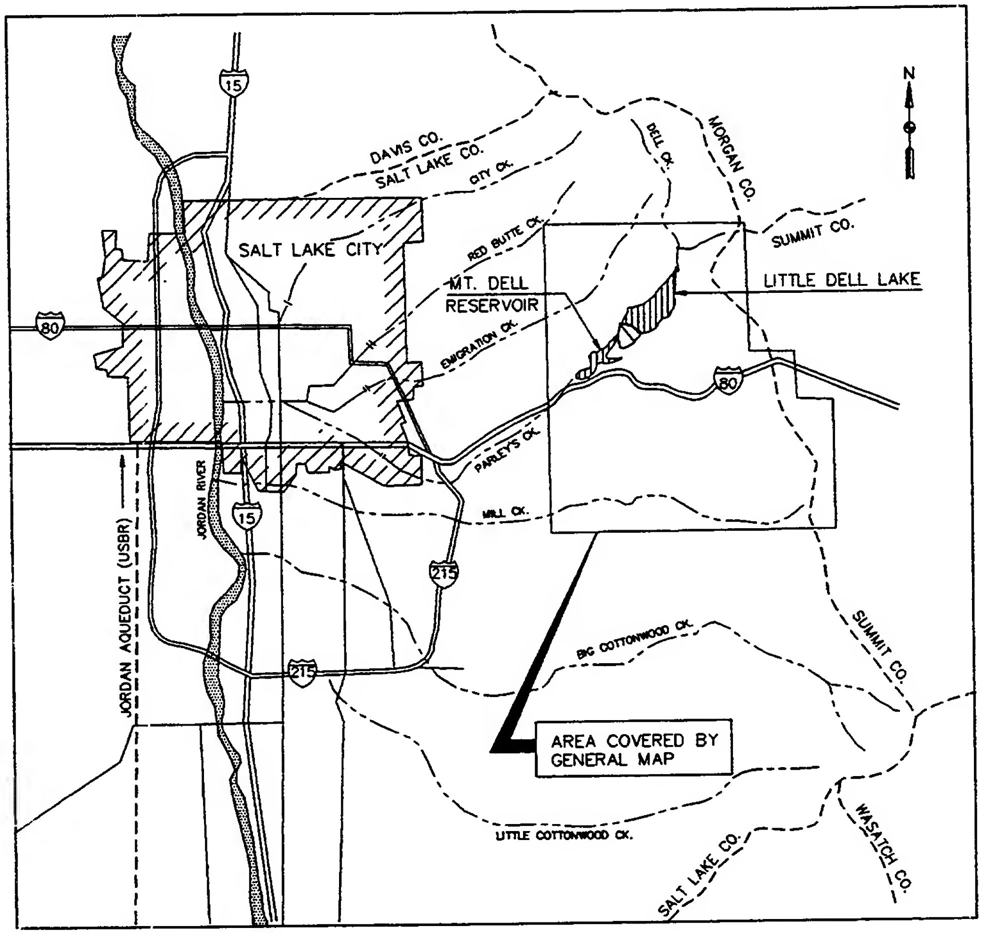
Figure 2



GENERAL MAP

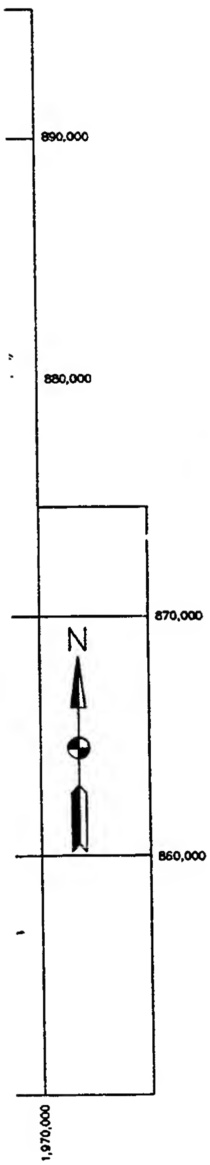
0 5,000 10,000

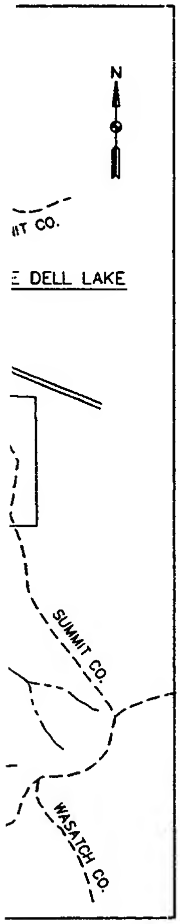
SCALE IN FEET

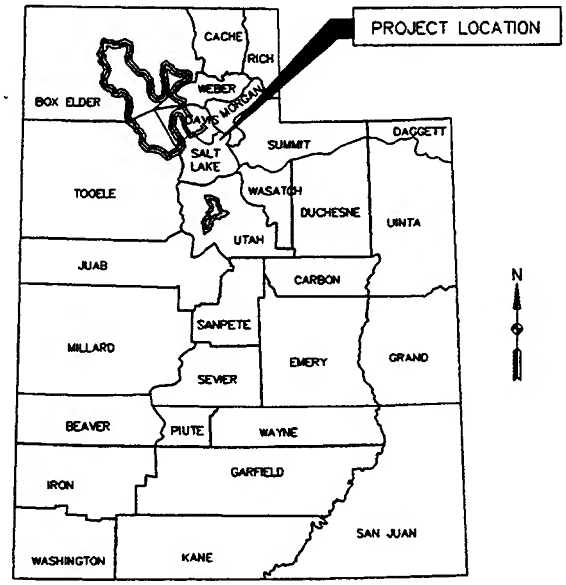


LOCALITY MAP

0 5
SCALE IN MILES







VICINITY MAP

0 50 100
SCALE IN MILES

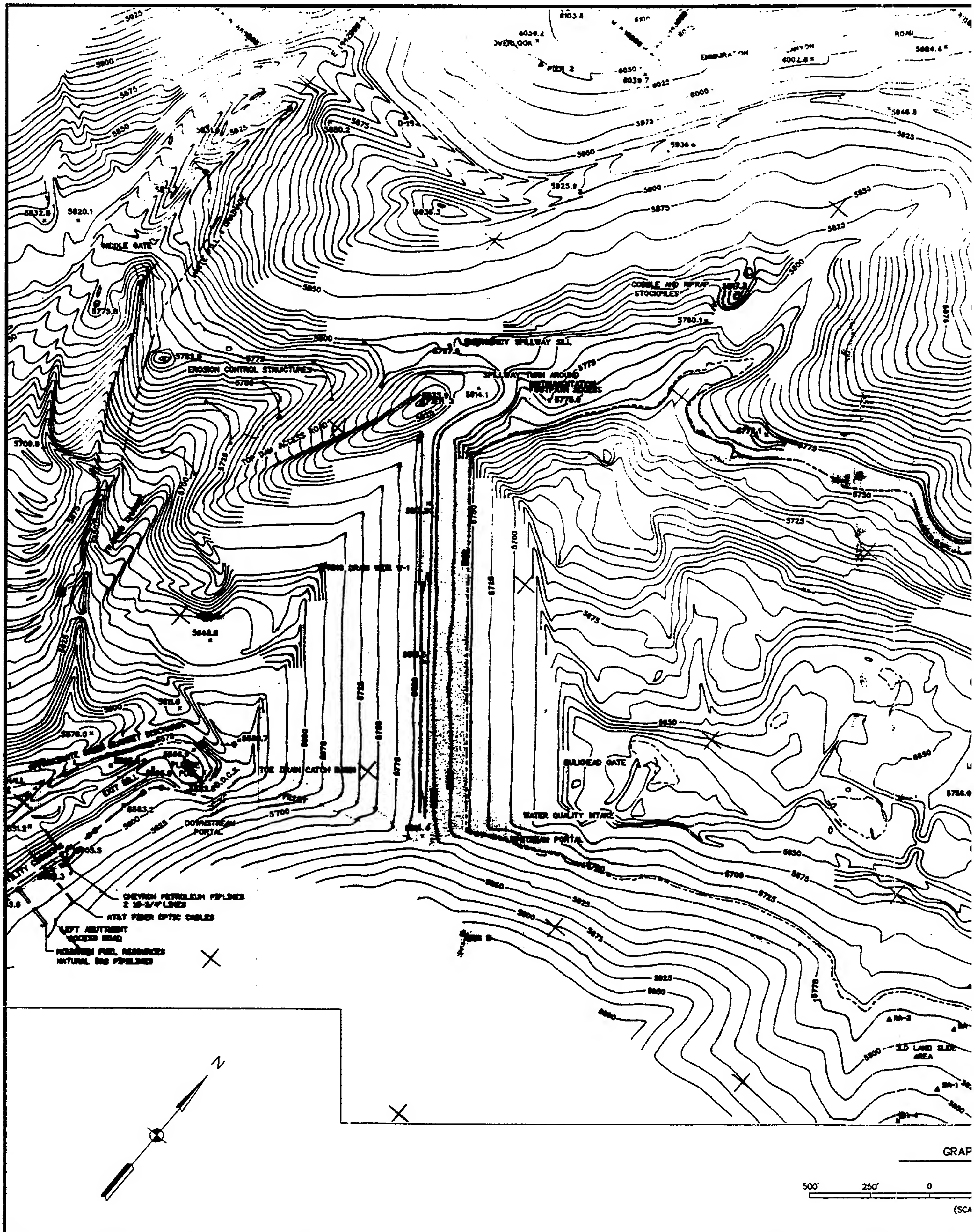
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

GENERAL LOCATION MAP

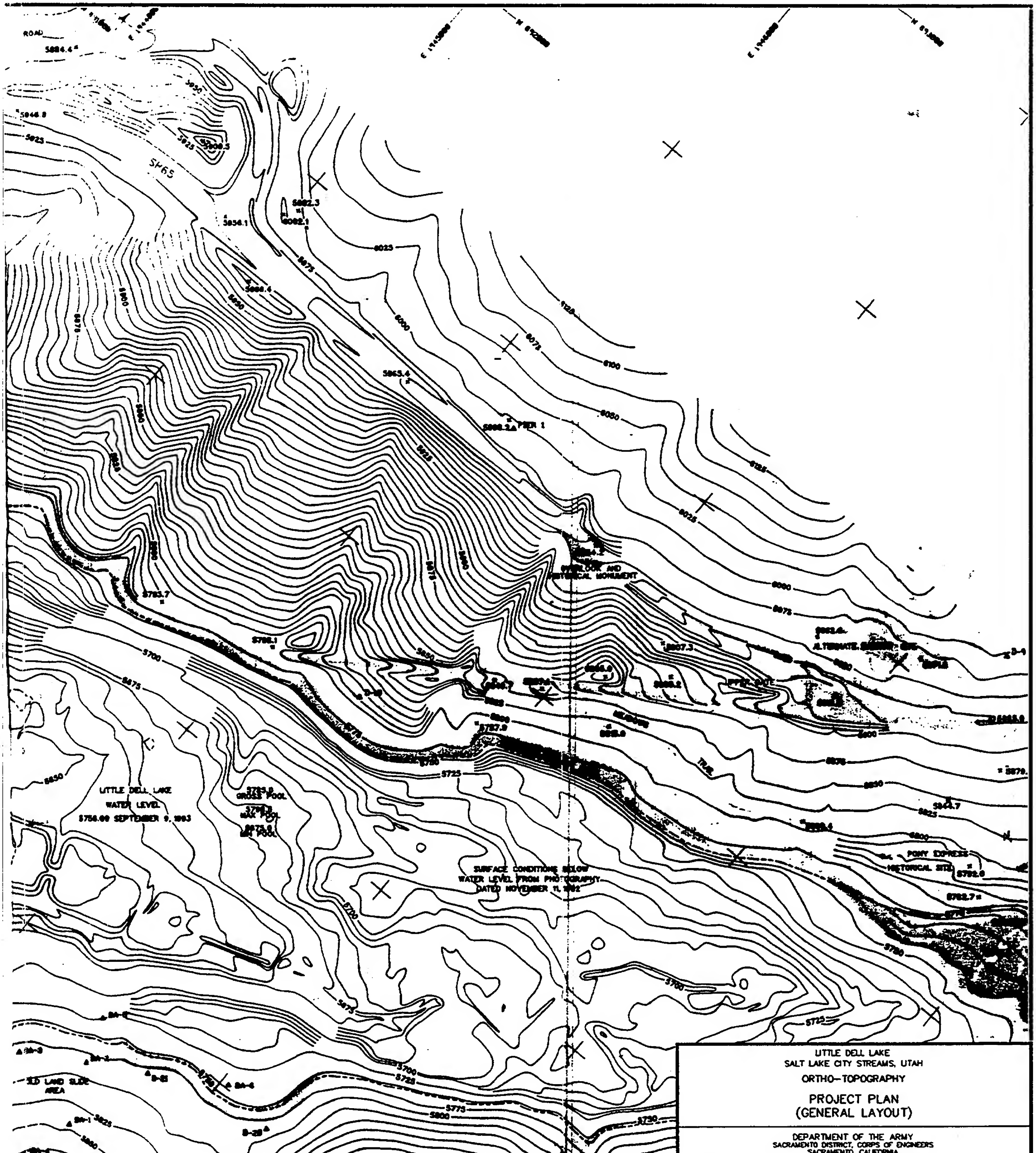
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
Robert L. Trent for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CHECKED BY:		FILE No.:
ERE	CEC		PLATE 1



C:\PROJECTS\LIDDELL\W-FORKPT\PL-02 05/23/95 09:15



GRAPHIC SCALE:

0 500' 1000'

(SCALE IN FEET)

SCALE: 1"=500'
CONTOUR INTERVAL: 5'
DATE OF PHOTOGRAPHY: SEPT. 9, 1993

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
ORTHO–TOPOGRAPHY

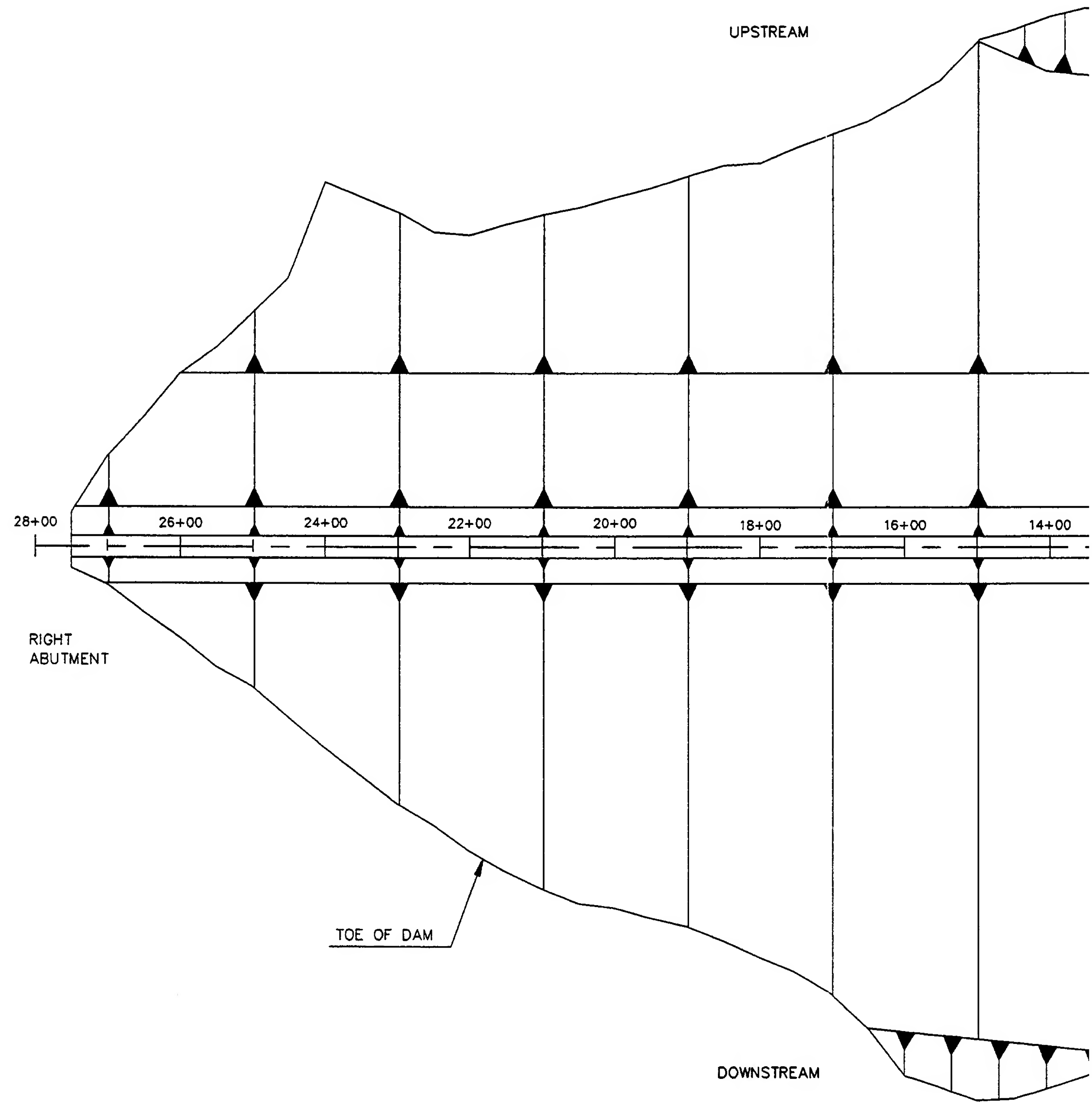
PROJECT PLAN
(GENERAL LAYOUT)

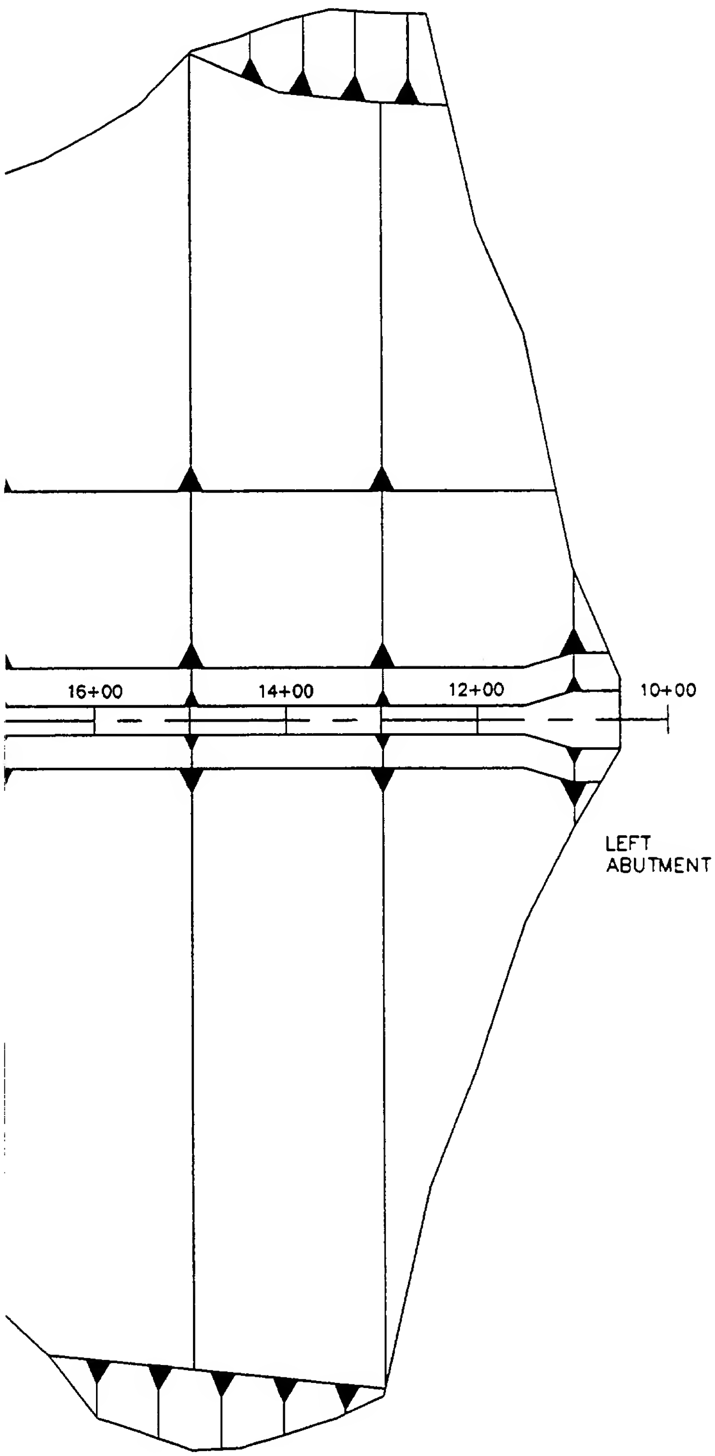
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

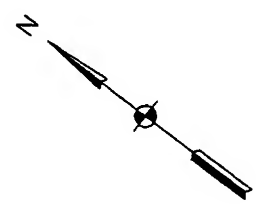
SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST

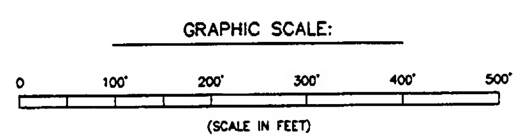
APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	CK. BY		FILE NO.
NLB		MDR	PLATE 2


UPSTREAM
28+00
26+00
24+00
22+00
20+00
18+00
16+00
14+00
RIGHT
ABUTMENT
TOE OF DAM
DOWNSTREAM







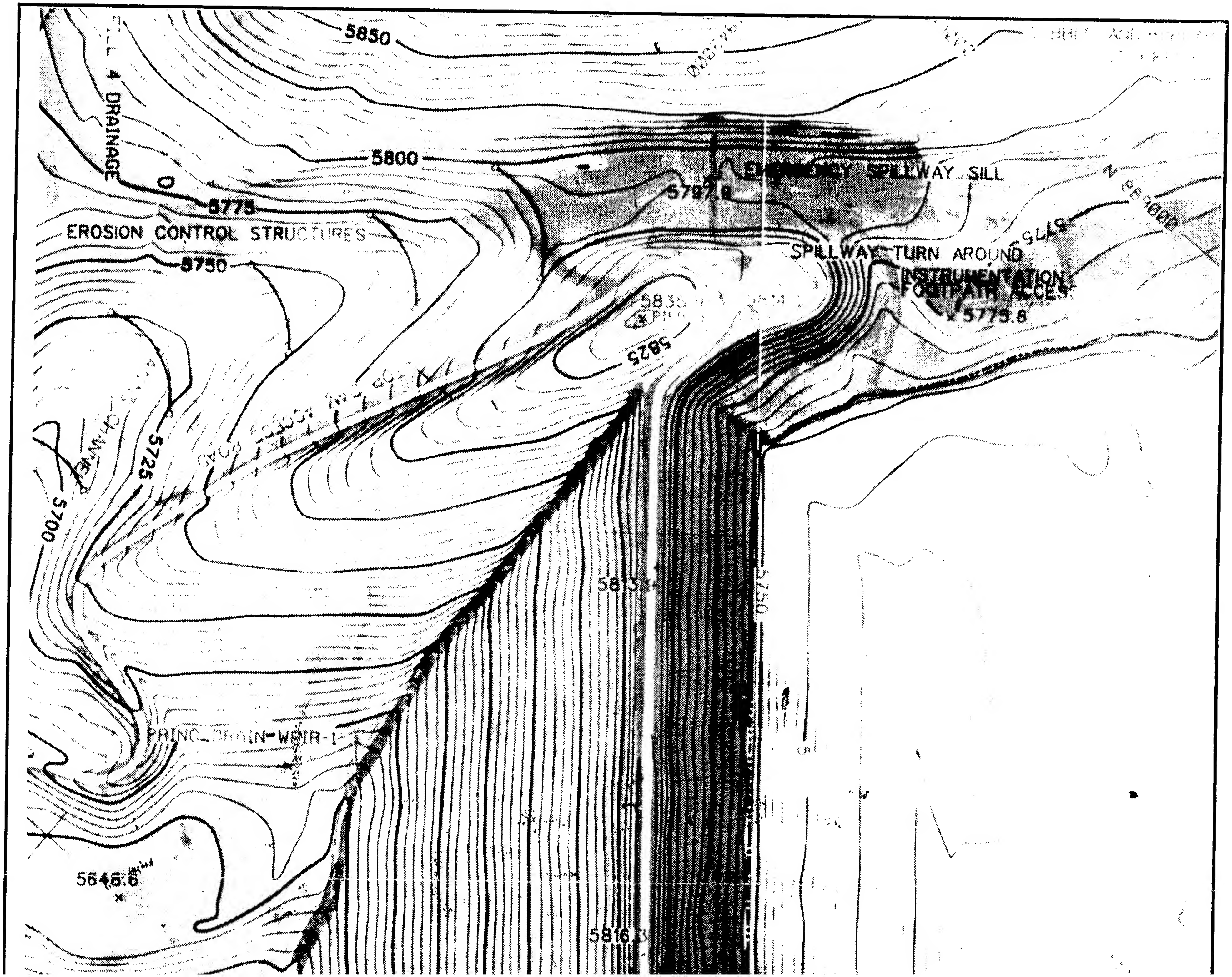
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

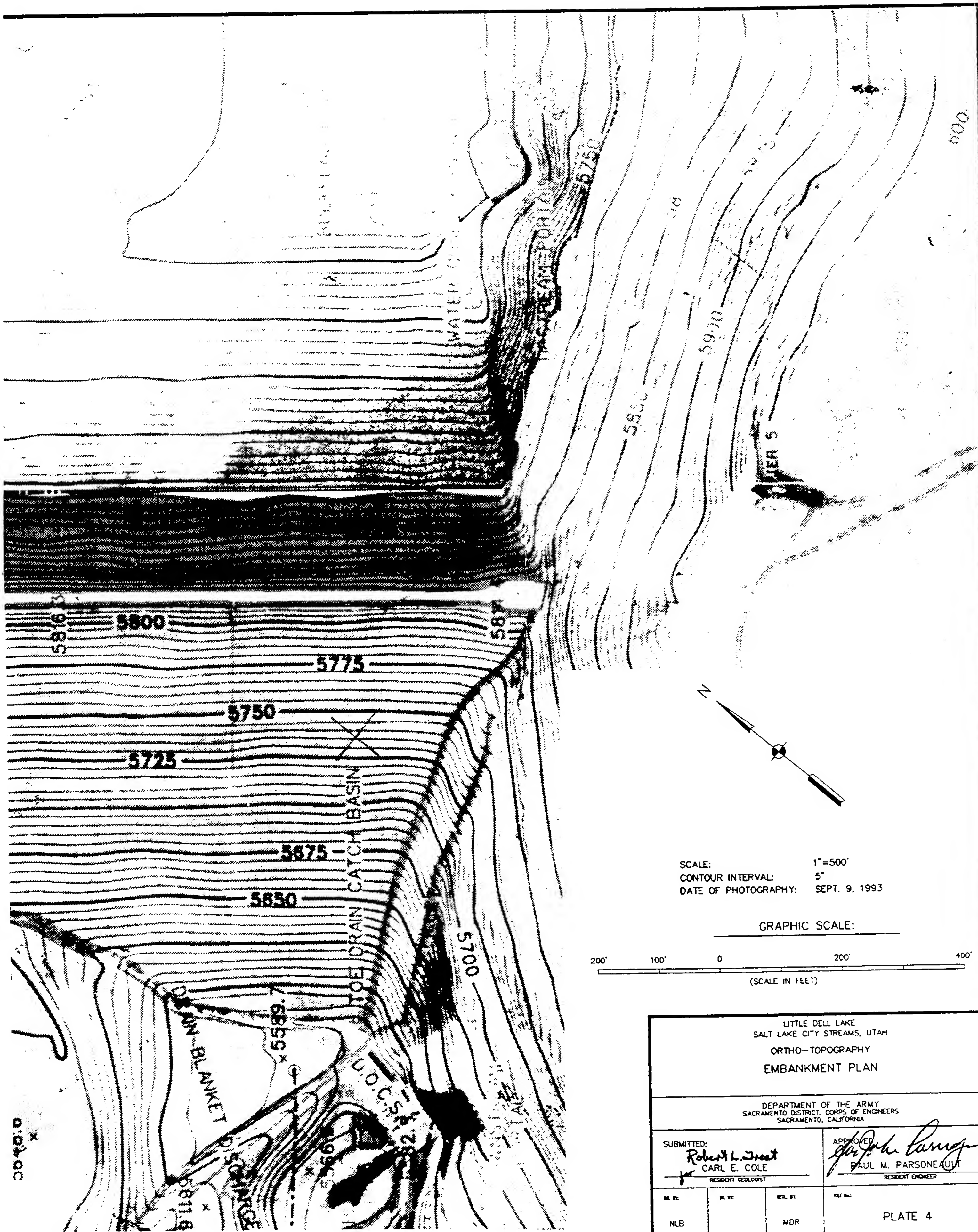
MAIN DAM
EMBANKMENT PLAN
END OF CONSTRUCTION–1992

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: for John Lavigne PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERC	TR. BY:	CKD. BY: BAB	FILE No: PLATE 3

C:\PROJECTS\LILDELL\W-FDNRPT\PI-04 03/23/95 09:17





SCALE: 1"=500'
CONTOUR INTERVAL: 5'
DATE OF PHOTOGRAPHY: SEPT. 9, 1993

GRAPHIC SCALE:

200' 100' 0 200' 400'

(SCALE IN FEET)

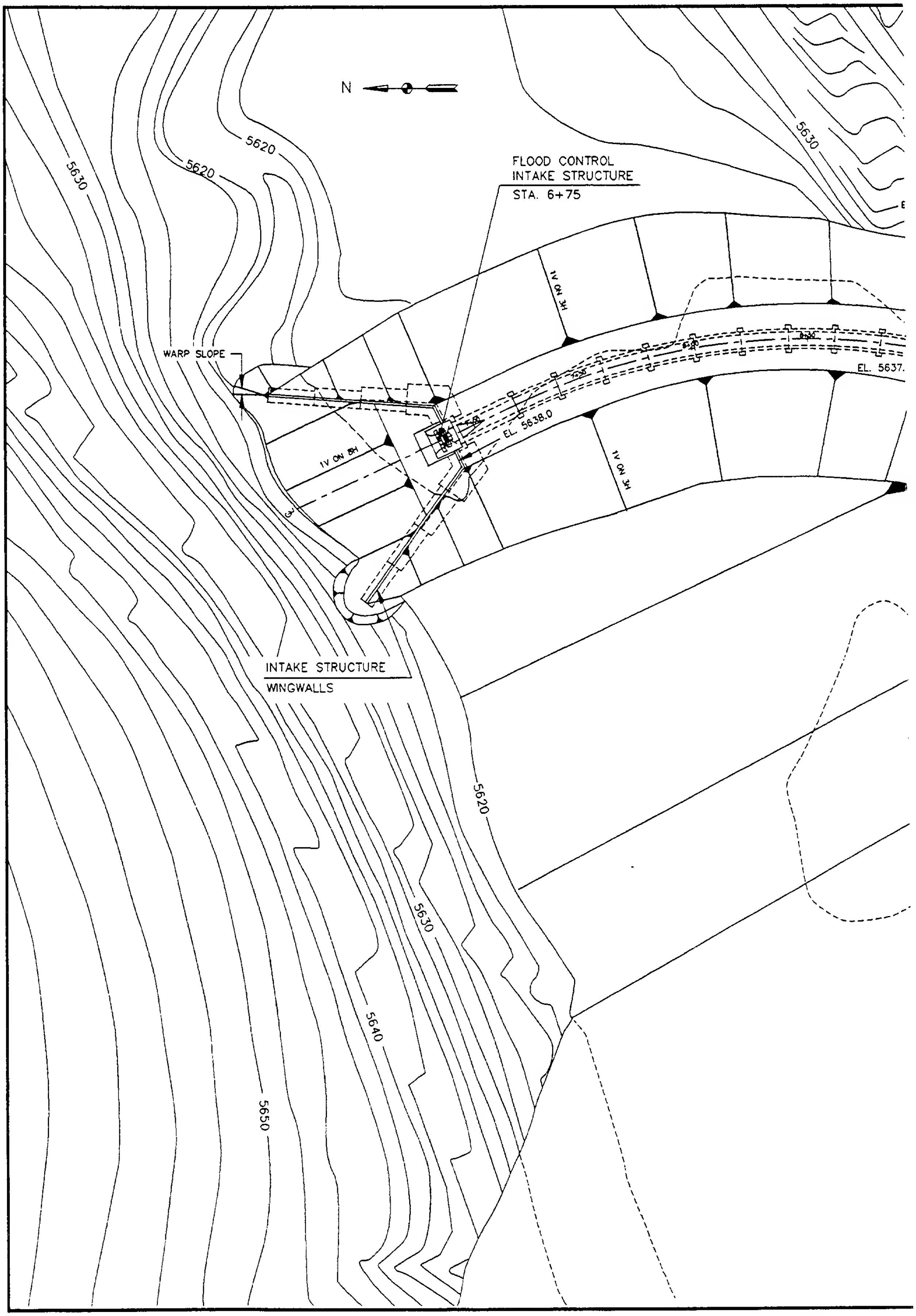
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

ORTHO-TOPOGRAPHY

EMBANKMENT PLAN

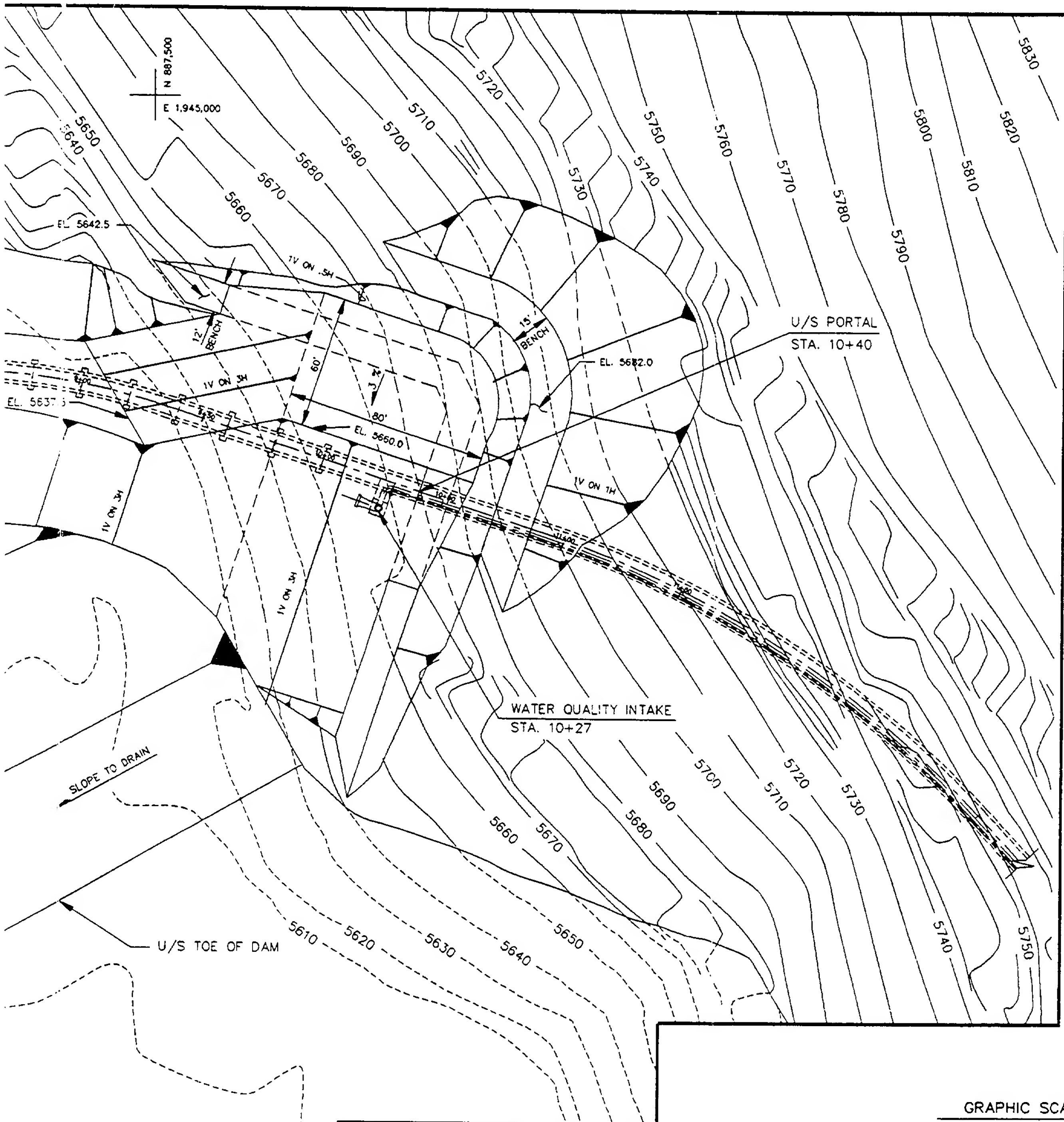
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: for John Parsoneault PAUL M. PARSONEAULT, RESIDENT ENGINEER
NLB		MDR	PLATE 4



N
FLOOD CONTROL
INTAKE STRUCTURE
STA. 6+75
5620
5620
5630
5630
WARP SLOPE
1V ON 3H
1V ON 6H
1V ON 3H
EL. 5638.0
EL. 5637.
INTAKE STRUCTURE
WINGWALLS
5620
5630
5640
5650

PLAN



GRAPHIC SCALE:

0 5' 10' 15' 20' 40' 60' 80' 100'

(SCALE IN FEET)

NOTES

1. TOPOGRAPHY PRODUCED BY PHOTOGRAMMETRIC METHODS, FROM AERIAL PHOTOGRAPHY DATED 6-21 & 24- 1987
2. GRID COORDINATES ARE REFERRED TO UTAH STATE COORDINATE SYSTEM, CENTRAL ZONE.
3. ELEVATIONS ARE BASED ON ELEVATION 5603.25 FOR STATE HIGHWAY BENCH MARK, STAMPED "R.P.-A, STA. 13+48.84, 1972, ELEV. 5603.25".
4. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM.

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

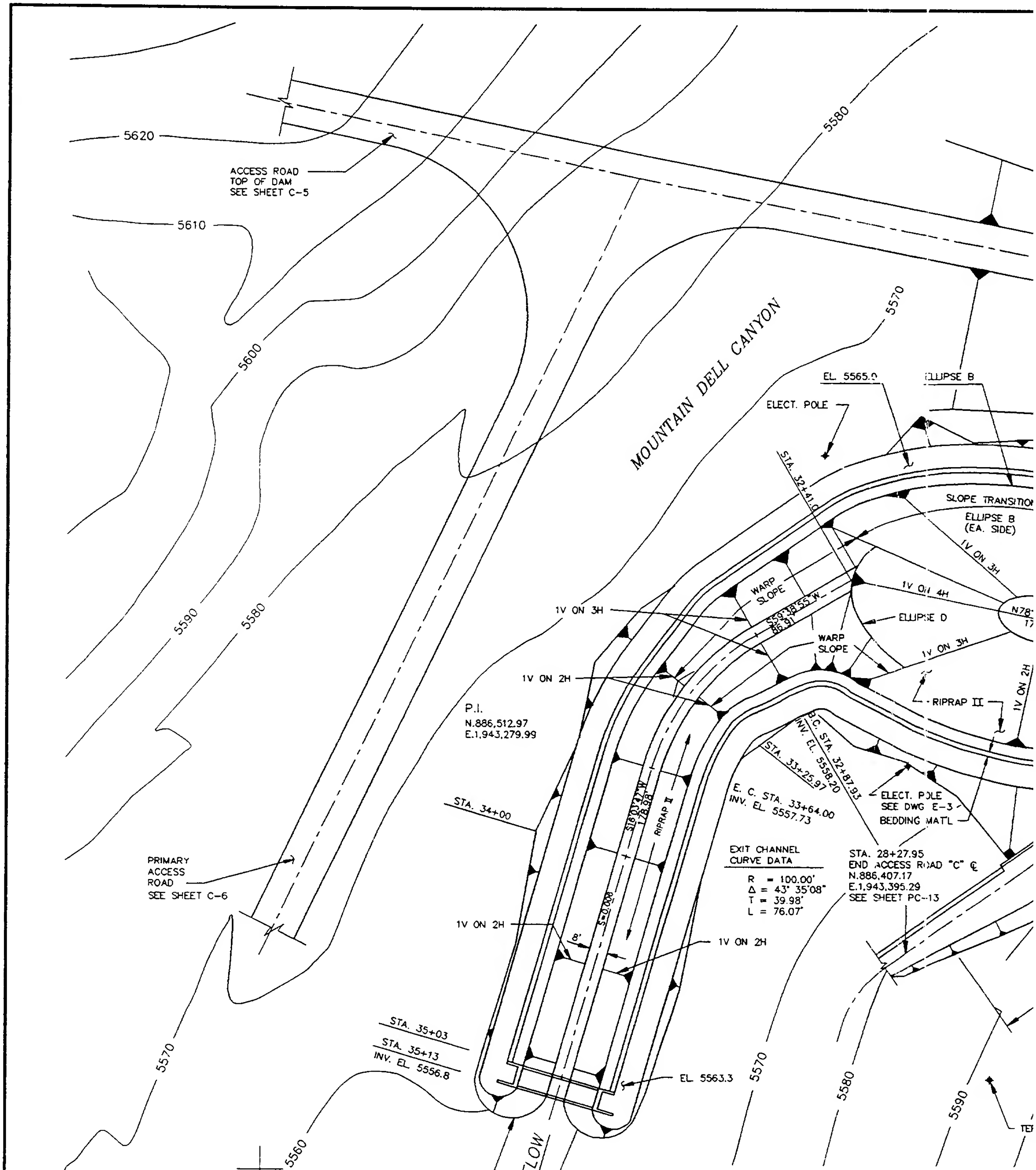
OUTLET WORKS

PLAN – INTAKE STRUCTURE AND CUT-AND-COVER CONDUIT

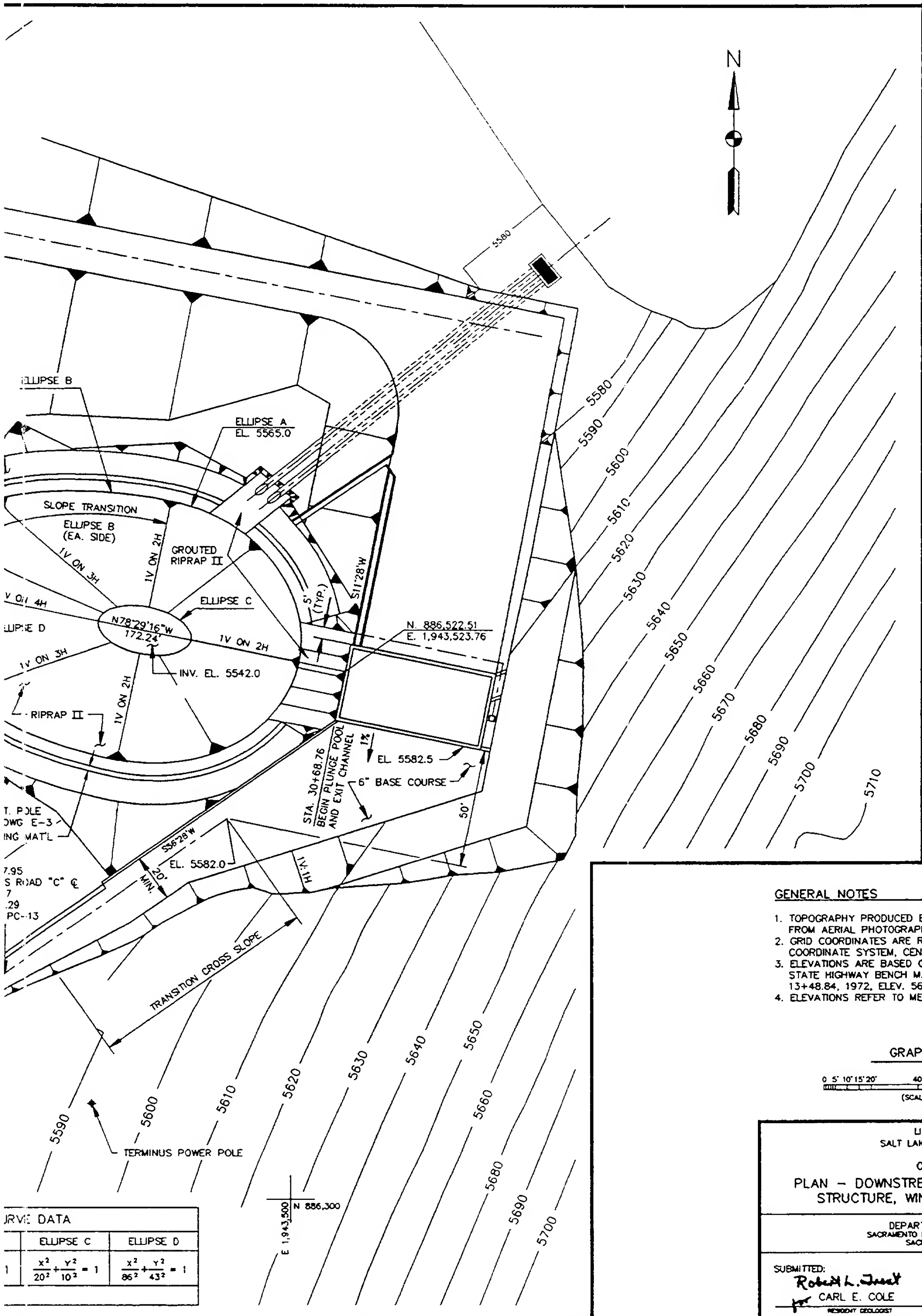
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
Robert L. Trost for CARL E. COLE, RESIDENT GEOLOGIST	for John Carrigan / PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	GEOL BY:	FILE No.:
ERE		BAB	PLATE 5



ELLIPSE CURVE DATA			
ELLIPSE A	ELLIPSE B	ELLIPSE C	EL
$\frac{x^2}{66^2}+\frac{Y^2}{56^2}=1$	$\frac{x^2}{112^2}+\frac{Y^2}{56^2}=1$	$\frac{x^2}{20^2}+\frac{Y^2}{10^2}=1$	$\frac{x^2}{86^2}$
ORIGIN AT ℄ STA. 31+55			



URVE DATA		
	ELLIPSE C	ELLIPSE D
1	$\frac{X^2}{20^2}+\frac{Y^2}{10^2}=1$	$\frac{X^2}{86^2}+\frac{Y^2}{43^2}=1$

GENERAL NOTES

1. TOPOGRAPHY PRODUCED BY PHOTOGRAMMETRIC METHODS, FROM AERIAL PHOTOGRAPHY DATED 6–21 & 24 – 1987.
2. GRID COORDINATES ARE REFERRED TO UTAH STATE COORDINATE SYSTEM, CENTRAL ZONE.
3. ELEVATIONS ARE BASED ON ELEVATION 5603.25 FOR STATE HIGHWAY BENCH MARK, STAMPED "R.P.–A, STA. 13+48.84, 1972, ELEV. 5603.25".
4. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM.

GRAPHIC SCALE:

0 5' 10' 15' 20' 40' 60' 80' 100'

(SCALE IN FEET)

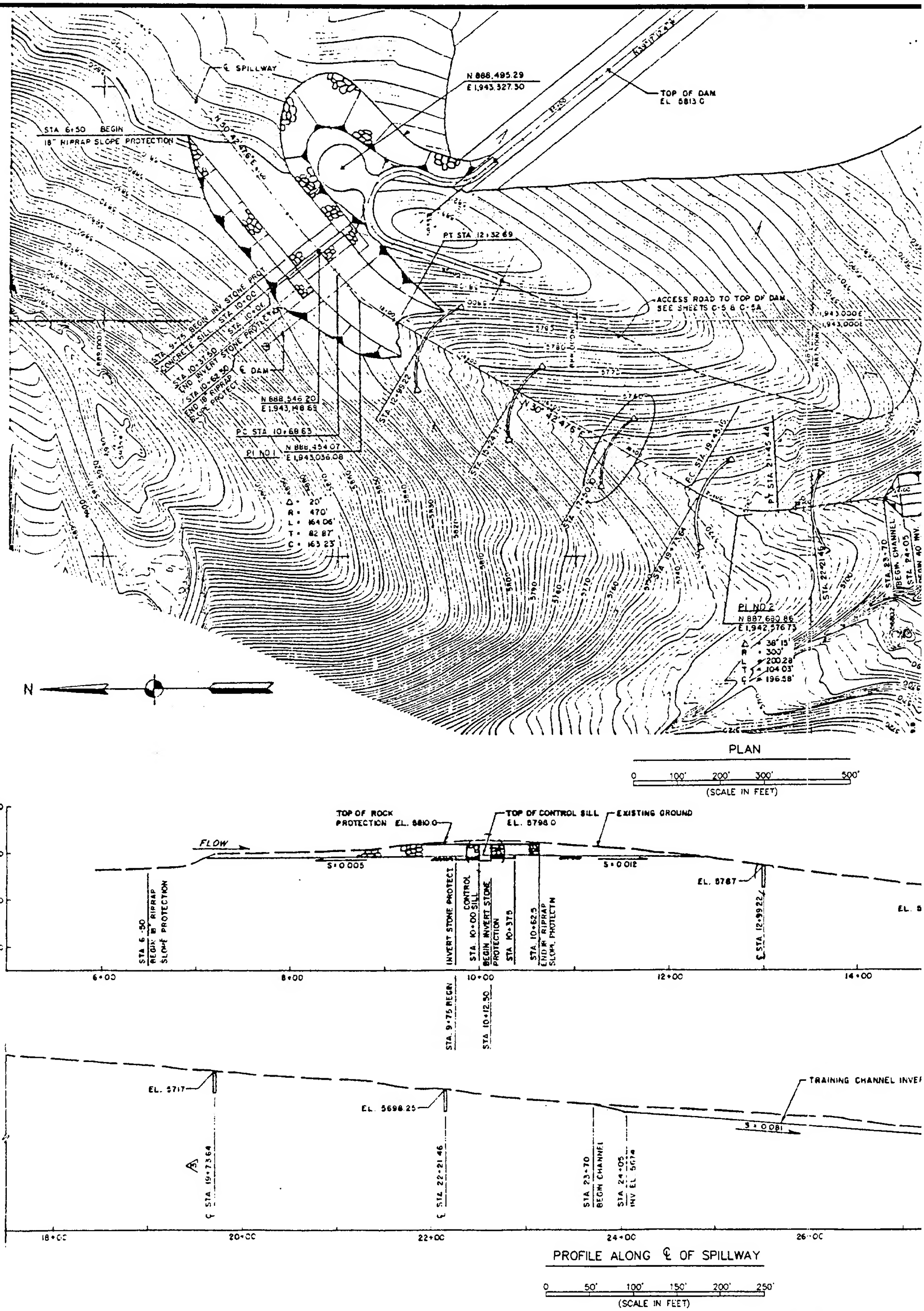
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

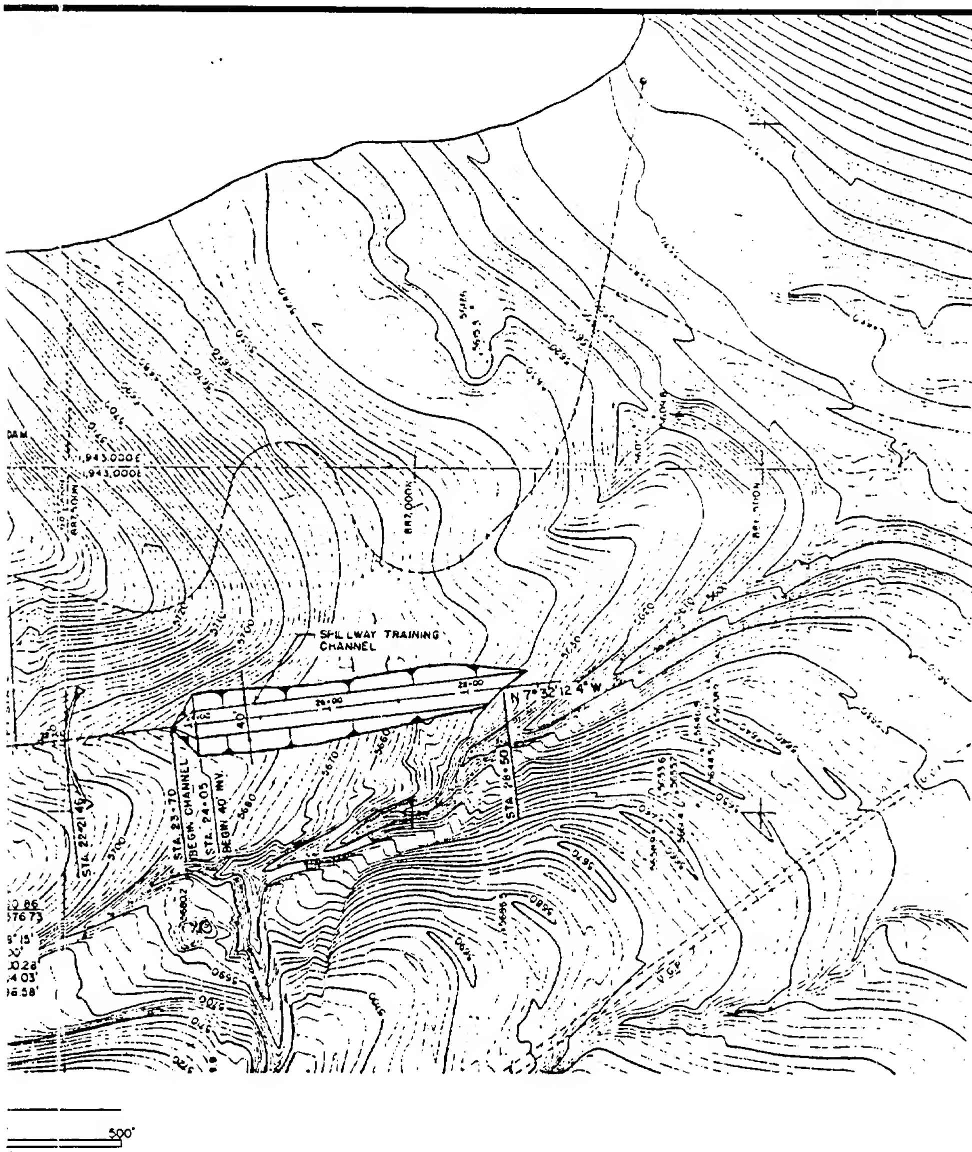
OUTLET WORKS

PLAN – DOWNSTREAM OPERATIONAL CONTROL STRUCTURE, WINGWALLS & PLUNGE POOL

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

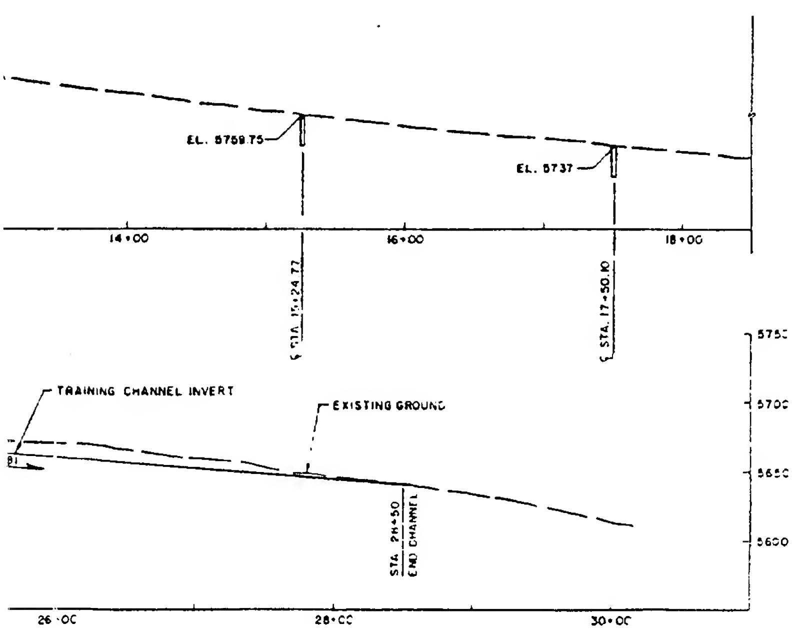
SUBMITTED: Robert L. Trust for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER		
DR. BY: ERE	TR. BY:	CKD. BY: BAB	FILE No.: PLATE 6


℄ SPILLWAY
N 888,495.29
E 1,943,327.30
TOP OF DAM
EL. 5813.0
STA 6+50 BEGIN
18" RIPRAP SLOPE PROTECTION
PT STA 12+32.69
ACCESS ROAD TO TOP OF DAM
SEE SHEETS C-5 & C-5A
STA 9+75 BEGIN INV STONE PROT
CONCRETE SILL STA 10+00
STA 10+37.50 END INVERT STONE PROTECT
STA 10+62.50 END 18" RIPRAP SLOPE PROTECT
℄ DAM
N 888,546.20
E 1,943,148.69
PC STA 10+68.63
PI NO 1
N 888,454.07
E 1,943,036.08
Δ = 20°
R = 470'
L = 164.06'
T = 82.87'
C = 163.23'
PI NO 2
N 887,680.86
E 1,942,576.73
Δ = 38°15'
R = 300'
L = 200.28'
T = 104.03'
C = 196.58'
N
PLAN
0 100' 200' 300' 500'
(SCALE IN FEET)
TOP OF ROCK PROTECTION EL. 5810.0
TOP OF CONTROL SILL EL. 5798.0
EXISTING GROUND
FLOW
S = 0.005
S = 0.012
EL. 5787
STA 6+50 BEGIN 18" RIPRAP SLOPE PROTECTION
INVERT STONE PROTECT
STA. 10+00 CONTROL SILL
BEGIN INVERT STONE PROTECTION
STA. 10+37.5
STA. 10+62.5 END 18" RIPRAP SLOPE PROTECTN
℄ STA 12+99.22
STA. 9+75 BEGIN
STA 10+12.50
5850
5800
5750
5700
6+00
8+00
10+00
12+00
14+00
TRAINING CHANNEL INVERT
EL. 5717
EL. 5698.25
S = 0.081
℄ STA 19+73.64
℄ STA 22+21.46
STA 23+70 BEGIN CHANNEL
STA 24+05 INV EL 5674
18+00
20+00
22+00
24+00
26+00
PROFILE ALONG ℄ OF SPILLWAY
0 50' 100' 150' 200' 250'
(SCALE IN FEET)



GENERAL NOTES:

1. TOPOGRAPHY PRODUCED BY PHOTOGRAMMETIC METHODS, FROM AERIAL PHOTOGRPHY DATED 6-21 & 24-1987
2. GRID COORDINATES ARE REFERRED TO UTAH STATE COORDINATE SYSTEM, CENTRAL ZONE.
3. ELEVATIONS ARE BASED ON ELEVATION 5603.25 FOR STATE HIGHWAY BENCH MARK STAMPED "R.P.-A, STA. 13+48.84, 1972, ELEV. 5603.25".
4. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM



GRAPHIC SCALES:

0 50' 100' 150' 200' 250'
(SCALE IN FEET)

0 100' 200' 300' 500'
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

SPILLWAY

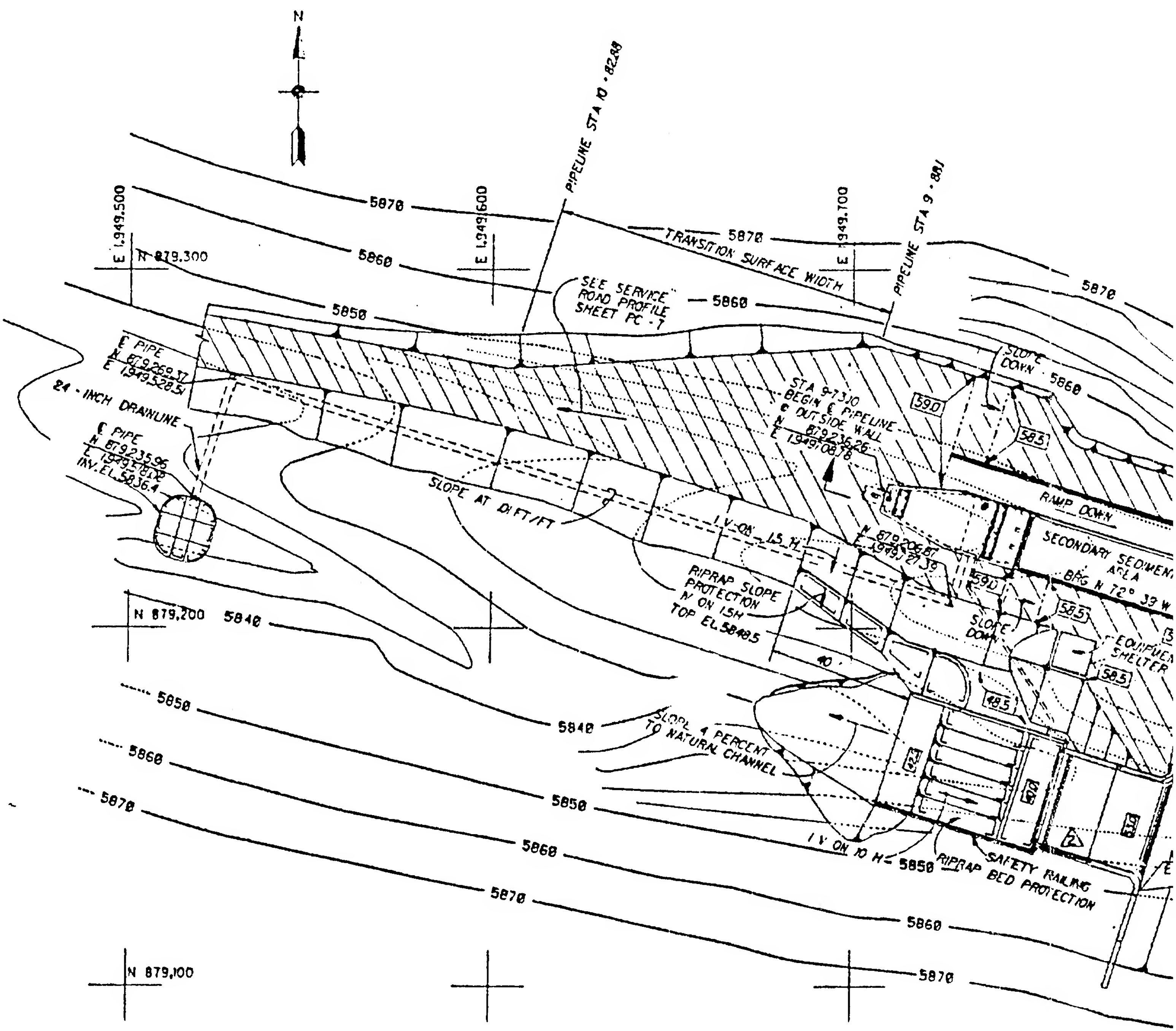
PLAN AND SECTION OF SPILLWAY

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST

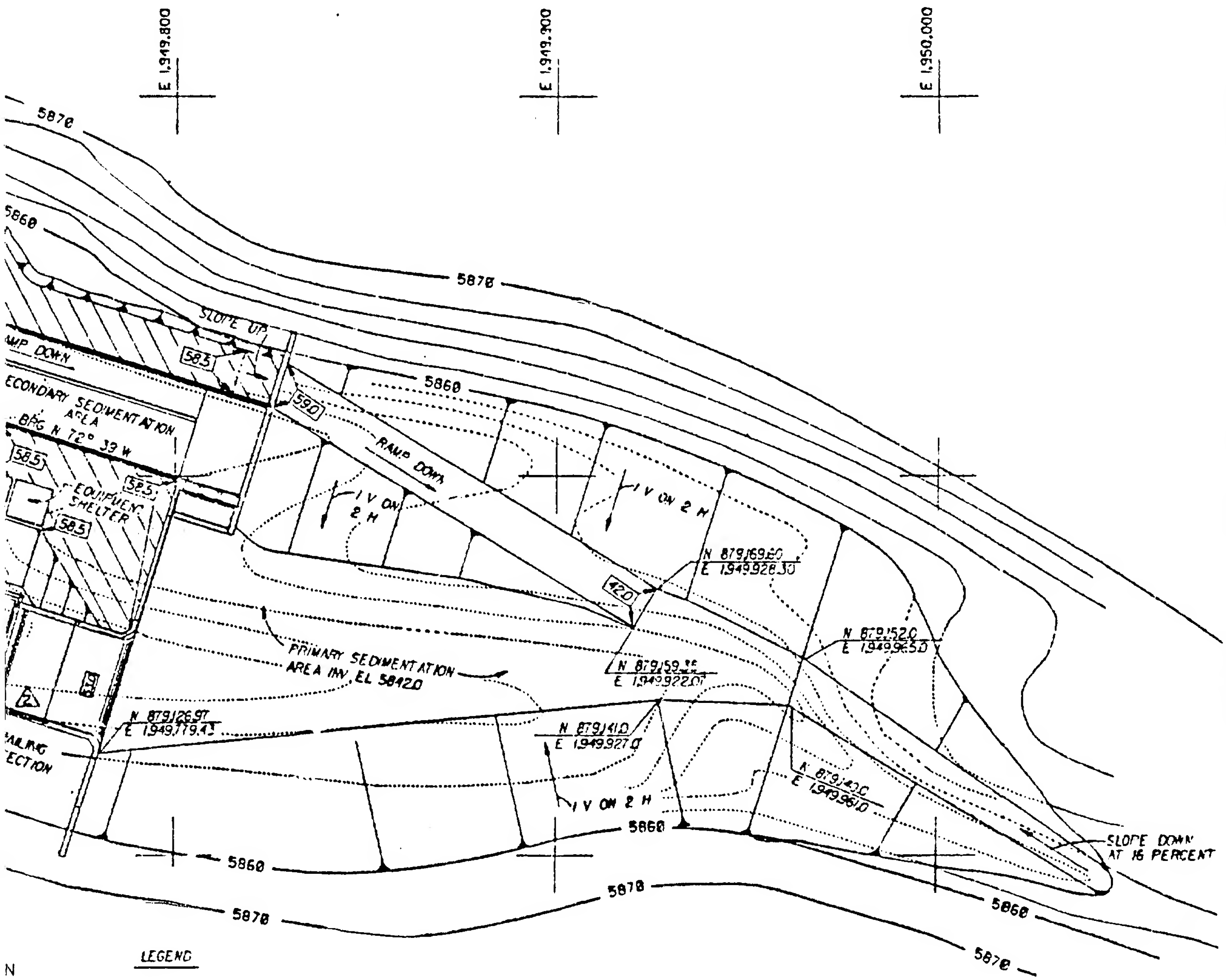
APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CK. BY:	GEOL. BY:	FILE NO:
ERE		BAB	PLATE 7



SITE PLAN

1. S
2. C



LEGEND

[585] FINISHED GRADE EL WITH REFERENCE TO DATUM OF 5800 FT. ABOVE MSL

AREAS TO RECEIVE 6 INCHES OF BASE COURSE

NOTE:

1. SEE PS-27 FOR ADDITIONAL LAYOUT INFORMATION.
2. CONTRACTOR RESPONSIBLE FOR DIVERSION OF WATER.

GRAPHIC SCALE:

0 20' 40' 60' 80' 100'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

PARLEY'S CREEK DIVERSION

PARLEY'S CREEK DIVERSION STRUCTURE
PLAN

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST		APPROVED: for John P. [illegible] PAUL M. PARSONEAULT, RESIDENT ENGINEER	
ERE		BAB	PLATE 8

DESCRIPTION OF MAP UNITS

(Isotopic ages have been recalculated from decay constants accepted by the U.S. Geological survey in 1984)

Qal Alluvium (Holocene)—Boulders to pebble gravel, sand, silt, and clay deposited in channels and flood plains of streams. Thickness as much as 3 m

Qf Alluvial-fan and debris-fan deposits (Holocene and Pleistocene)—Gravel, sand, and silt; locally bouldery. Crudely bedded to nonbedded and poorly sorted. Maximum thickness probably 10 m

Ql Landslide deposits (Holocene and Pleistocene)—Poorly sorted; particle size ranges from clay to blocks, depending on material involved in sliding; include mudflow, debris-avalanche, and slump deposits

Qoa Old alluvium (Pleistocene)—Gravel, silty gravel, and sandy silt in dissected alluvial fans and alluvium. Includes local marsh deposits. Much of the units in the valley near Keetley is more than 730,000 years old (Sullivan and Nelson, 1983). In Salt Lake valley, upper Pleistocene alluvial deposits merge with regressive-phase deposits of Lake Bonneville. More than 100 m thick in valley near Keetley; 2–7 m thick in Salt Lake valley

Deposits of regressive phase of Lake Bonneville (Pleistocene)

Qpg Sand and gravel deposits—Sandy gravel, gravely sand, and silty gravel. Includes deposits attributed by Miller (1980) to Stansbury lake stand. Thickness 1–4 m

Deposits of the high stand of Lake Bonneville (Pleistocene)

Qbc Silt and clay deposits—Sandy, clayey silt, sand, or silty clay. Massive to thinly bedded. Thickness as much as 8 m

Qbg Sand and gravel deposits—Sand, silty sand, sandy pebble and cobble gravel, and gravelly sand. Thickness 1–30 m

Qtp Till of Pinedale age (Pleistocene)—Poorly sorted bouldery till that forms prominent moraines. As mapped, may include some colluvium, talus, and landslide debris. A few meters thick except in moraines where maximum thickness is 180 m

Qof Older alluvial-fan and debris-fan deposits (Pleistocene)—Poorly sorted gravel, sand, and silt; locally bouldery. Crudely bedded to nonbedded. Occur above present drainage and are inactive. Maximum thickness about 10 m

Qtg Gravel (Pleistocene or Pliocene)—Unconsolidated pebble, cobble, and boulder gravel on Porcupine Ridge and adjacent areas near northeast corner of quadrangle. Apparently gravel is a lag concentrate from underlying conglomerate (unit Toc). Also mapped on Slader Ridge in east-central part of quadrangle. Maximum thickness possibly a few tens of meters

Hooper Canyon Formation (Pliocene?)—Boulders, cobbles, and pebbles in a matrix of sand and silt. Coarse clasts are predominantly subrounded to subangular limestone and quartzite. Caps ridges north of City Creek and lies on erosion surface cut on deformed conglomerate (Tc). Maximum thickness 15 m

Tc Conglomerate (Miocene?)—Pale-brown and light- to medium-gray, well- to poorly cemented, pebble and cobble conglomerate and sandstone. Generally contains coarse, subrounded to subangular clasts of limestone and quartzite, but near Mill Creek southeast of Bountiful, clasts of metamorphic rocks from the Farmington Canyon Complex are numerous. Thickness greater than 500 m

Tkb Light-gray to gray lahar, flow breccia, and tuff—Proportion of tuff increases with distance from volcanic centers. Sandstone and conglomerate composed of volcanic clasts occur distal to volcanic centers. Zircon fission-track age of 35.3 Ma and biotite K-Ar age of 37.5 Ma obtained from flow breccia north of Salt Lake City (Van Horn, 1981). Thickness as much as 500 m in Keetley region

Toc Conglomerate (Oligocene and Eocene?)—Boulder, cobble, and pebble conglomerate containing fragments of sandstone derived from Mesozoic and upper Paleozoic formations; clasts of Nugget Sandstone (Unit J̄Rn) are conspicuous. Contains a few lahars and beds of tuff and volcanic gravel. Locally rich in clasts of volcanic rock in Porcupine Ridge area in northeastern part of quadrangle. In the adjoining Ogden 30'x60' quadrangle to the north, unit is mapped as basal member of Norwood Tuff. Maximum thickness about 300 m

Wasatch Formation (Eocene and Paleocene)—Moderate-red, grayish-red, pale-red, reddish-brown, and gray sandstone, conglomerate, siltstone, and claystone; contains scattered, thin, lenticular beds of light-purplish-gray to light-gray, nonmarine limestone. Conglomerate clasts range from pebble to boulder size and have a varied lithology from diverse sources. Maximum stratigraphic thickness about 1,500 m in the Mountain Dell-Porterville area on the east side of the Wasatch Range and about 1,200 m north of the Uinta Mountains. In Chalk Creek area, yellowish-gray-weathering conglomerate forms a basal unit as much as 100 m thick overlain by a sequence of variegated sandstone and siltstone. This sandstone and siltstone is overlain by or interfingers with coarse conglomerate to the south, which was derived from Paleozoic and Precambrian rocks of the Uinta uplift. Palynomorphs indicate the lower 200–300 m is of late Paleocene age (Lamerson, 1982; Nichols, 1982; and this report)

Conglomerate dominant

Frontier Formation (Upper Cretaceous)

Kfu Upper member—Light-yellowish-gray marine sandstone, gray marine shale, gray to brown siltstone and silty shale, and coal. Conglomerate, which occurs at the base of the unit as a bed 6–30 m thick in the Coalville area, contains rounded pebbles and cobbles of sandstone and limestone. Conglomeratic beds are numerous along the Weber River valley at Franklin Canyon. In Coalville area units contain middle Coniacian fauna 330 m above base and at top (Ryer, 1976). Thickness 800–1,100 m in Coalville area. Thickness 1,600 m in East Canyon Creek area

Oyster Ridge Sandstone Member—Light-yellow to gray marine sandstone and pebbly sandstone locally overlain by nonmarine sandstone, siltstone, and silty shale. Contains early middle Turonian ammonite, Collignoniceras woolgari (Cobban and Reeside, 1952). Thickness 60–100 m

Kfl Lower member—Light- to dark-gray marine shale, sandstone, conglomeratic sandstone, and silty shale; coal; and gray, light-red, grayish-red, and green claystone. Contains earliest Turonian fossils about 1,000 m above base and early middle Turonian fossils in the upper 240 m in Coalville area (Ryer, 1976). Thickness 1,370 m in Coalville area and about 1,800 m along East Canyon Creek

Kfcg Conglomerate facies—Conglomerate containing interbeds of sandstone and, rarely, of red and gray clay. Conglomerate contains rounded pebbles and cobbles of sandstone and limestone from the Mesozoic and upper Paleozoic section. Locally contains boulders as much as 1 m in diameter. Three tongues of conglomerate in East Canyon Creek area merge to the west into a body 1,300 m thick

Kelvin Formation (Lower Cretaceous)

Kk Upper member—Yellowish-gray, grayish-red, and light- to moderate-red sandstone; gray, reddish-brown, and grayish-red siltstone and claystone; and conglomerate. Conglomerate beds thicker and more numerous west of East Canyon Creek; contains pebbles and cobbles of sandstone, siltstone, and minor amounts of limestone. Unit about 1,300 m thick in Turner Hollow area; thins to west and south. About 470 m thick near head of Parleys Canyon

Kkp Parleys Member—Light- to pale-gray limestone associated with pale-lavender-gray siltstone containing limestone nodules; reddish-brown siltstone, pale-brown to pale-reddish-brown sandstone, and conglomerate. About 50 m thick

Jp Preuss Sandstone (Middle Jurassic)—Reddish-brown, grayish-red, and light- to moderate-red silty sandstone, sandstone, and silty shale. Contains anhydrite and salt in the subsurface in the Chalk Creek area and east of Franklin Canyon (Lamerson, 1982). About 300 m thick, but locally has been thickened due to deformation and flowage of salt, anhydrite, and associated shales

Jt Twin Creek Limestone (Middle Jurassic)—Thin- to medium-bedded, gray, light-gray, and purplish-gray limestone and some beds of grayish-red to brown siltstone and sandstone. Locally fossiliferous. Thickness ranges from 850 m near Parleys Canyon to 400 m near Peoa

JTRn Nugget Sandstone (Jurassic? and Triassic?)—Pale-grayish-orange, fine-grained sandstone, and white quartz sandstone. Crossbedded in upper part, planar bedded in lower part. Thickness ranges from 400 m in Parleys Canyon to 380 m near Peoa

Ankareh Formation

TRau Upper member (Upper Triassic)—Moderate-red, grayish-red, and grayish-purple mudstone and fine-grained sandstone. Thickness about 210 m in Wasatch Range and 110 m in western Uinta Mountains

Gartra Member (Upper Triassic)—White to pale-purple, massive, crossbedded, coarse-grained to pebbly quartzite. Thickness as much as 70 m in Wasatch Range and 20–30 m in Uinta Mountains

TRam Mahogany Member (Lower Triassic)—Purplish-gray and pale-red sandstone, mudstone, and a few thin limestone beds. Thickness ranges from 260 m in Wasatch Range to 225 m on northwest flank of Uinta Mountains

TRt Thaynes Limestone (Lower Triassic)—Light-gray, thin- to thick-bedded limestone and brownish-gray siltstone containing beds of light-gray sandstone, pale-red silty limestone, light-gray shaly limestone, and dark-greenish-gray siltstone and shale. Locally contains pelecypods, gastropods, and ammonites. Thickness ranges from 600 m north of Red Butte Creek to 215 m on northwest flank o Uinta Mountains

TRw Woodside Formation (Lower Triassic)—Grayish-red, grayish-purple, reddish-brown, and moderate-red shale, siltstone, and fine-grained sandstone; thin white limestone beds; and grayish-red siltstone. Locally, a few tens of meters of green or greenish-gray shale and siltstone at the base. Thickness ranges from 120 m north of Red Butte Creek east of Salt Lake City to 300 m near Park City

Ppc Park City Formation and related rocks (Permian)—Fossiliferous and cherty, gray to pinkish-gray limestone, calcareous siltstone, and cherty sandstone; near middle of unit is a dark-gray, phosphatic shale which is about 30 m thick (Meade Peak Phosphatic Shale Member of Phosphoria Formation). Thickness ranges from 200 m at Mill Creek southeast of Salt Lake City to 600 m at South Fork Dry Creek northeast of Salt Lake City

IPw Weber Sandstone (Pennsylvanian)—Pale-yellowish-gray to white, crossbedded, quartzitic and calcareous sandstone containing a few beds of light-gray to white limestone and dolomite. Thickness generally 300–500 m, but ranges from 150 to 750 m south of City Creek Canyon, where thinned by bedding faults and thickened by folding or fault repetition, and 600 m east of head of American Fork Canyon along the south-central edge of the quadrangle. Unit is Middle Pennsylvanian in Wasatch Range (Van Horn and Crittenden, 1988), but in Uinta Mountains upper part may be younger

IPr Round Valley Limestone (Lower Pennsylvanian)—Light-gray-weathering, gray to dark-gray, fossiliferous limestone containing gray and reddish-gray chert and interbeds of gray and light-green shale and siltstone, grayish-red silty shale, and sandstone and sandy limestone. Pale-reddish-orange silicified fossils are characteristic. Thickness ranges from 300 m in Wasatch Range in City Creek area to 60 m on eastern edge of quadrangle

Doughnut Formation (Upper Mississippian)—Medium-gray, thinbedded limestone containing pods of dark-gray to black chert and abundant fossils; a 10–30-m-thick zone of black, greenish, or locally reddish shale at the base contains thin beds of greenish-gray to rusty-weathering, silty limestone. Black shale containing thin beds of dark-gray limestone and rusty-weathering sandstone occurs in Uinta Mountains. Thickness about 130 m in Wasatch Range and 65 m in Uinta Mountains

Mgb Great Blue Formation (Upper Mississippian)—Pale-gray, thickbedded, fine-grained limestone. Identified only in a fault slice near Black Mountain northeast of Salt Lake City. Thickness 100 m

Mh Humburg Formation (Upper Mississippian)—Medium- to dark-gray limestone, dolomite, and limestone breccia containing beds of reddish-brown- to yellowish-gray-brown-weathering sandstone and rare interbeds of red siltstone. Thickness 120–280 m

Md Deseret Limestone (Upper and Lower Mississippian)—Thick-bedded dolomite and limestone locally containing abundant lenses and pods of dark-gray chert. A 10–12 m-thick zone of black phosphatic shale and thin-bedded limestone at base. Occurs only in Wasatch Range. Thickness 140–295 m

Mg Gardison Limestone(Lower Mississippian)—Medium- to dark-gray, thin- to thick-bedded, fossiliferous limestone. Occurs only in Wasatch Range. Thickness about 200 m

Pinyon Peak Limestone (Upper Devonian)—Pale-tan to pale-gray, thin-bedded, nodular limestone containing interbeds of gray shale. Occurs only north and northeast of Salt Lake City. Thickness 50–60 m

Ds Stansbury Formation (Upper Devonian)—Pale-gray to yellowish-gray, coarse-grained, crossbedded sandstone and calcareous siltstone; yellowish-weathering silty limestone; and grayish-red to bright-red shale. Basal part contains pale-gray to white, laminated dolomite; dark-gray, coarse-grained dolomite; and a quartzite bed 1 m thick at the base. Occurs only north and northeast of Salt Lake City. Thickness about 150 m

Maxfield Limestone (Middle Cambrian)—Contains upper member of dark-gray, medium-bedded, oolitic dolomite; middle member of mottled dolomite, limestone, and nodular shale; and lower member of massive, dark-gray, mottled dolomite and limestone having yellowish-gray silty laminae. Occurs only in Wasatch Range. Thickness is 360 m north of City Creek

Ophir Formation (Middle Cambrian)—Contains upper member of blocky-weathering, calcareous sandstone; middle member of thin-bedded limestone having yellowish-gray silty laminae; and lower member of olive-gray, micaceous shale. Thickness is 125 m in Big and Little Cottonwood Canyons area. North of City Creek, members are not distinguishable and thickness is only 57 m

Tintic Quartzite (Middle and Lower Cambrian)—Medium- to thick-bedded, fine- to coarse-grained, white, pale-yellowish-gray, and pale-reddish-brown quartzite; conglomeratic beds in lower 100 m. Thickness 250–600 m in Wasatch Range. Discontinuous lenses of unit as much as 100 m thick locally are preserved below pre-Late Devonian unconformity around Uinta Mountains

Afs Schist and gneiss (Archean)—Biotite-feldspar-quartz gneiss, garnet-biotite-feldspar-quartz gneiss, sillimanite-biotite schist, sillimanite-garnet-biotite schist and gneiss, hornblende-biotite schist, and less abundant layers of white, coarse-grained quartzite; lenses and layers of amphibolite. Pegmatite dikes and sills; pegmatites with sharp contacts tend to be discordant and to cut those with indistinct contacts. Discordant pegmatites with sharp contacts are generally 10–30 m long, but a few are several hundred meters long

Afsq Schist, gneiss, and quartzite (Archean)—Includes biotite-feldspar-quartz schist, sillimanite-biotite schist, sillimanite-garnet-biotite schist and gneiss, and interlayered, coarse-grained, white to pale-yellowish-green quartzite in beds as much as 10 m thick. Quartzite dominates much of the unit, has a grain size of 4–5 mm; contains some light-green muscovite and a few heavy mineral partings Contact with units Afs is gradational

LEGEND:

Contact

Fault–Dashed where approximate or inferred; dotted where concealed. Many faults have a complex history; only the sense of most recent movement shown on map. Relative movement shown on cross section by arrow; double–headed arrow indicates opposite movement sense at different times.
A, away from observer, T, toward observer

High–angle–Bar and ball on downthrown side

Thrust–Sawteeth on upper plate

Folds–Arrow shows direction of plunge where known. Dashed where approximate or inferred: dotted where concealed

Anticline

Overturned anticline

Syncline

Overturned syncline

30 Strike and dip of bedding
Inclined

60 Overturned bedding

Vertical bedding

40 Strike and dip of foliation and compositional layering where parallel
Inclined

60 Strike and dip of foliation
Inclined

REFERENCE

Geologic map of the Salt Lake City 30' x 60' quadrangle, North–Central Utah, and Uinta County, Wyoming. . .
by Bruce Bryant 1990

Palynologic data from Cretaceous and lower Tertiary rocks in the Salt Lake City 30' x 60' quadrangle. . .
by D. J. Nichols and Bruce Bryant

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

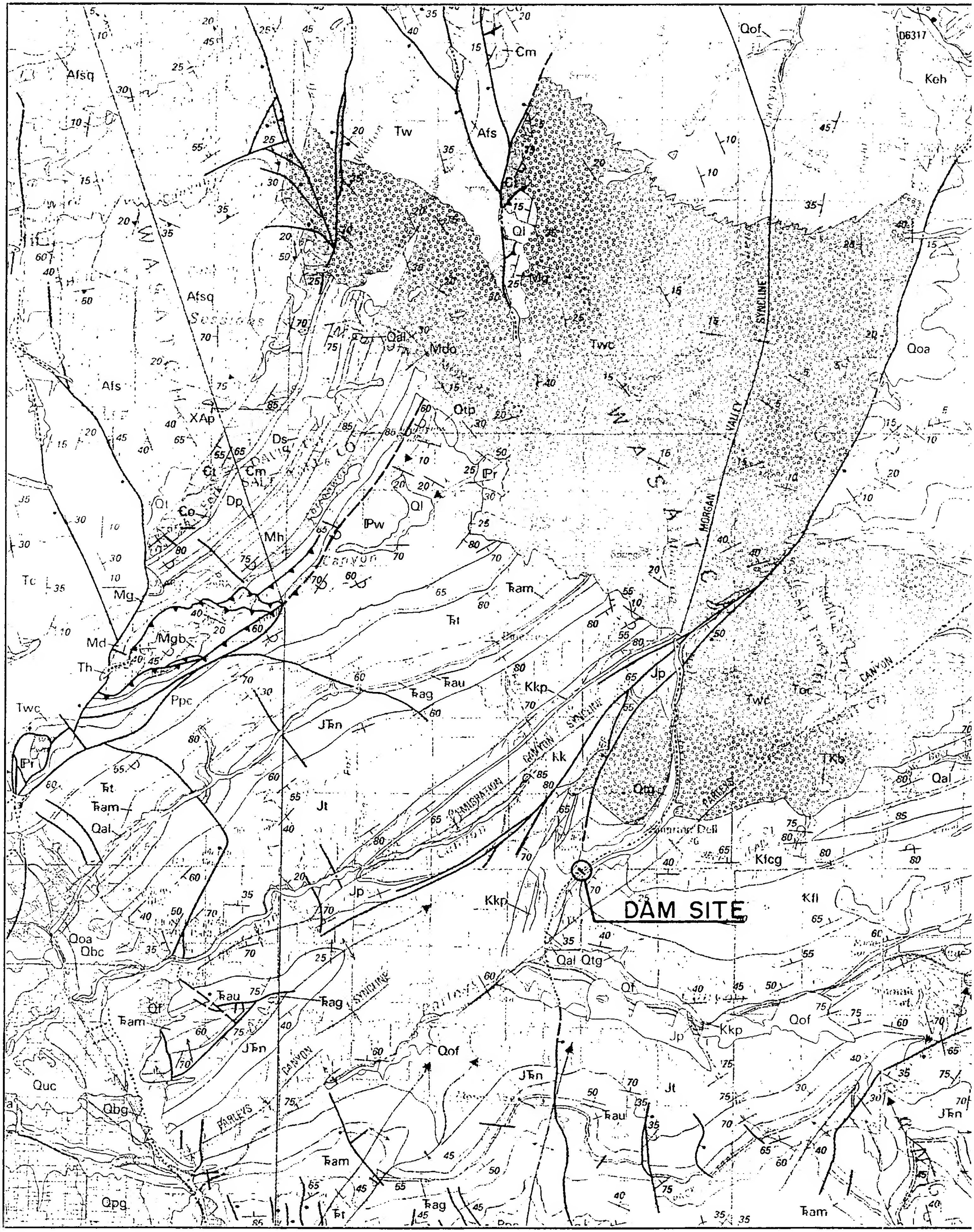
REGIONAL GEOLOGY
DESCRIPTION OF MAP UNITS

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

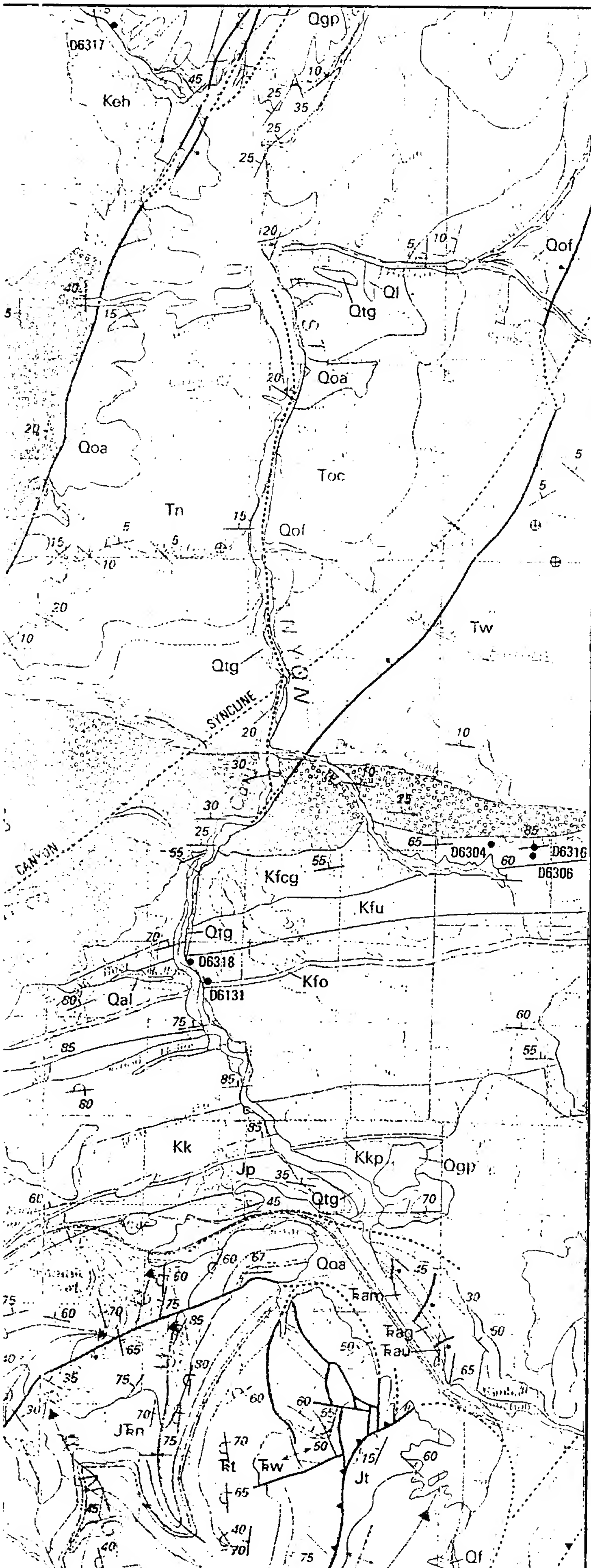
SUBMITTED:
for CARL E. COLE
RESIDENT GEOLOGIST

APPROVED:
PAUL M. PARSONEAULT
RESIDENT ENGINEER

DR. BY:	TR. BY:	CK. BY:	FILE No:
ERE		BAB	PLATE 9



DAM SITE
D6317
MORGAN VALLEY SYNCLINE
EMIGRATION CANYON SYNCLINE
PARLEYS CANYON SYNCLINE
PARLEYS CANYON



NOTES:

1. Refer to Plate 9 for legend and description of map geologic units.

REFERENCE/SOURCE:

Geologic map of the Salt Lake City 30' x 60' quadrangle, North-Central Utah, and Uinta County, Wyoming. . .
by Bruce Bryant 1990

Palynologic data from Cretaceous and lower Tertiary rocks in the Salt Lake City 30' x 60' quadrangle. . .
by D. J. Nichols and Bruce Bryant

N

GRAPHIC SCALE:

0 1 2 3 4 5

(SCALE IN MILES)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

REGIONAL GEOLOGY

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:		APPROVED:
Robert L. Trust for CARL E. COLE, RESIDENT GEOLOGIST		PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	CK. BY	REQ. BY	FILE No.
ERE		BAB	PLATE 10

GEOLOGIC MAP LEGEND (

KELVIN AND FRONTIER FORMATIONS (BEDROCK)

Kf — FRONTIER FORMATION: Light to dark gray marine shale, sandstone, conglomeratic sandstone, and silty shale; coal; and gray, light red, grayish-red, and green claystone.

Kk — KELVIN FORMATION: Yellowish-gray, grayish-red, and light to moderate red sandstone; gray, reddish-brown, and grayish-red siltstone; gray, reddish-brown, and grayish-red siltstone, claystone, and conglomerate.

1 — SANDSTONE: Gray and brownish-gray; hard to very hard where unweathered; generally fine grained; slightly to highly fractured; solutioning evident along many fractures; fractures exhibit widths of one inch or greater in some cases; strikes of most open fractures are generally nearly perpendicular to bedding; calcareous-siliceous matrix; high permeabilities (300+ feet per day (Ft/d) possible in moderately fractured zones where calcareous matrix has been dissolved along fractures. Numerous springs observed exiting thin beds of hard sandstone along downstream left abutment.

2 — SILTY SANDSTONE/SANDY SILTSTONE: Predominantly reddish-brown and reddish-brown with gray mottling; moderately soft to moderately hard where unweathered; intensely to slightly fractured; fracture widths generally smaller than in the gray sandstone; moderate permeabilities possible through fractures generally not along bedding; air slakes readily in some cases; calcareous; some thin beds and zones of gray sandstone as described above are included in these units.

3 — SILTSTONE: Predominantly brown and reddish-brown with gray mottling, some gray beds; generally moderately soft to soft; intensely to slightly fractured, fractures generally tight with some small openings; fracture orientations highly variable; low permeabilities; usually air slakes readily; calcareous.

4 — CLAYSTONE: Predominantly reddish-brown and gray mottled, some gray beds; generally soft to very soft; often intensely fractured; fractures generally tight and at random orientations; relatively impervious; air slakes readily; variably calcareous.

5 — CLAYSTONE: Light and dark gray, and greenish-gray beds; generally soft to very soft; generally intensely fractured with tight platy fractures; relatively impervious; air slakes readily; generally non-calcareous.

6 — ALTERED BED: Gray to gray-green; variably altered; very soft; intensely sheared; tight fractures.

LEGEND AND SYMBOLS

6a — MONTMORILLONITE: Dark gray-green, variably altered; very soft; intensely sheared; tight fractures; slakes readily in water.

7 — CONGLOMERATE: Multicolored coarse material in gray matrix; hard to very hard matrix with very hard quartzitic coarse material where unweathered; generally slightly fractured at surface but highly fractured in cores from depth; large fractures often exceed 1 inch in width, open fractures generally not along bedding; calcareous matrix.

8 — INTRAFORMATIONAL BRECCIA: Dark gray to black with multicolored fragments; moderately soft to soft; highly to moderately fractured, fractures mostly tight.

OVERBURDEN

9 — SLOPEWASH: Sandy clay and clayey sand with gravel, cobble and boulder size sandstone fragments; brownish-gray and grayish-brown with light gray fragments; generally firm to stiff.

10 — FINE GRAINED OLDER ALLUVIUM: Sandy clay; brown to reddish-brown; generally firm with a soft area in the Random II foundation near Sta 19+00; 50 to 95 per cent medium to high plasticity fines with fine and very fine sand; damp where firm, wet where soft.

11 — OLDER ALLUVIUM-UPPER GRAVEL BED: Gravel and cobbles with boulders in a sandy and clayey sandy matrix; multicolored coarse material in a reddish brown matrix; dense to very dense; coarse material consists primarily of quartzite with smaller amounts of sandstone and limestone.

12 — OLDER ALLUVIUM-BASAL GRAVEL COBBLE BOULDER UNIT: Gravel, cobbles and boulders in a sandy and clayey sandy matrix; multicolored coarse material in a reddish brown matrix; dense; coarse material consists primarily of well rounded quartzite with smaller amounts of sandstone and limestone, generally becomes coarser with depth.

13 — YOUNGER ALLUVIUM (HOLOCENE): Boulders to pebble gravel, sand, silt, and clay deposited in channels and flood plains of streams. Light to dark gray, loose to dense.

14 — YOUNGER ALLUVIUM - SAND, GRAVEL, COBBLES AND BOULDERS: Light to dark gray, loose to dense.

LEGEND:

(line)	GEOLOGIC CONTACT
7° DIP / STRIKE	JOINT
(wavy line)	SHEAR OR FAULT
(arrows)	FAULT
(symbol)	SPRING

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

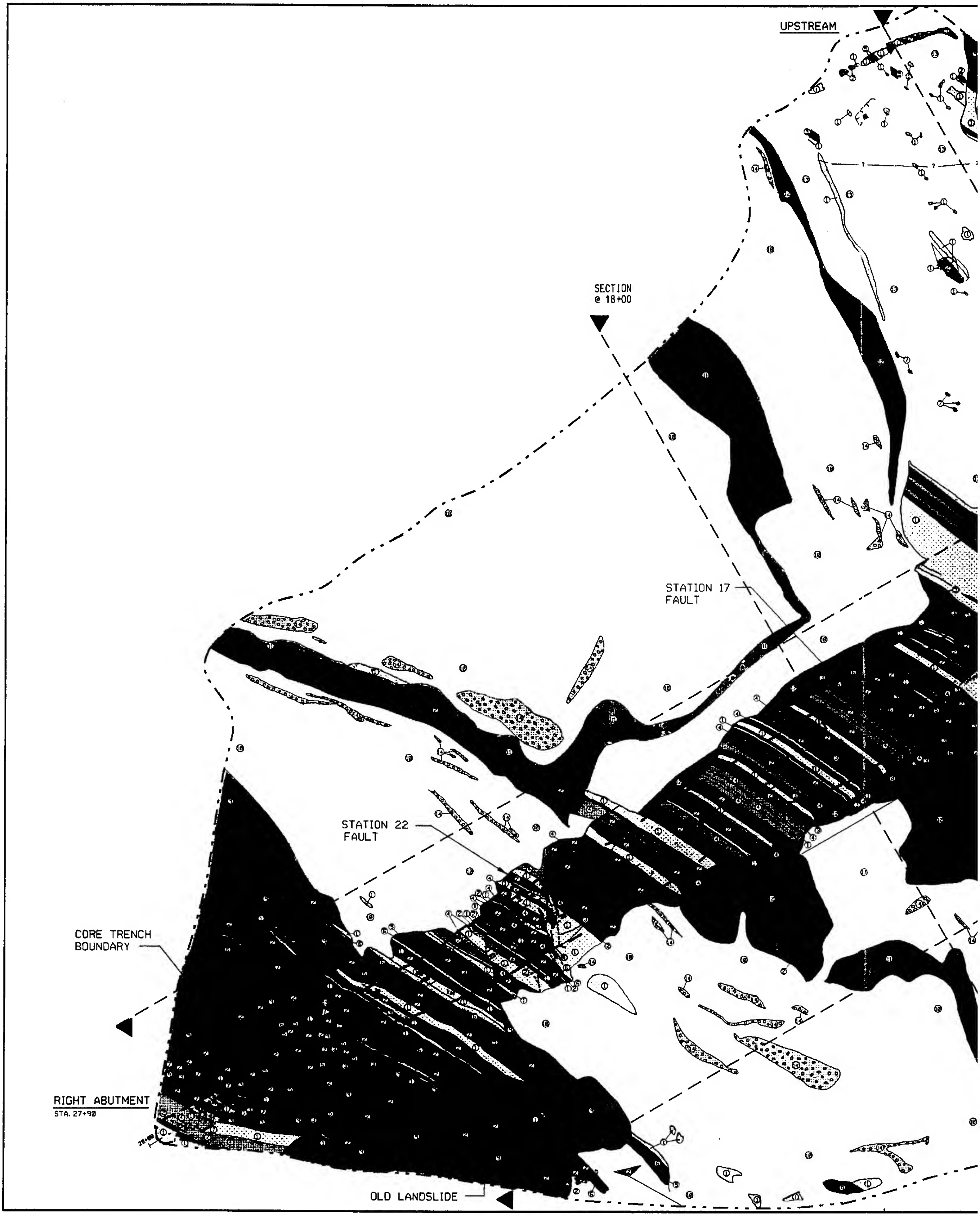
MAIN DAM
GEOLOGIC MAP
LEGEND AND SYMBOLS

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

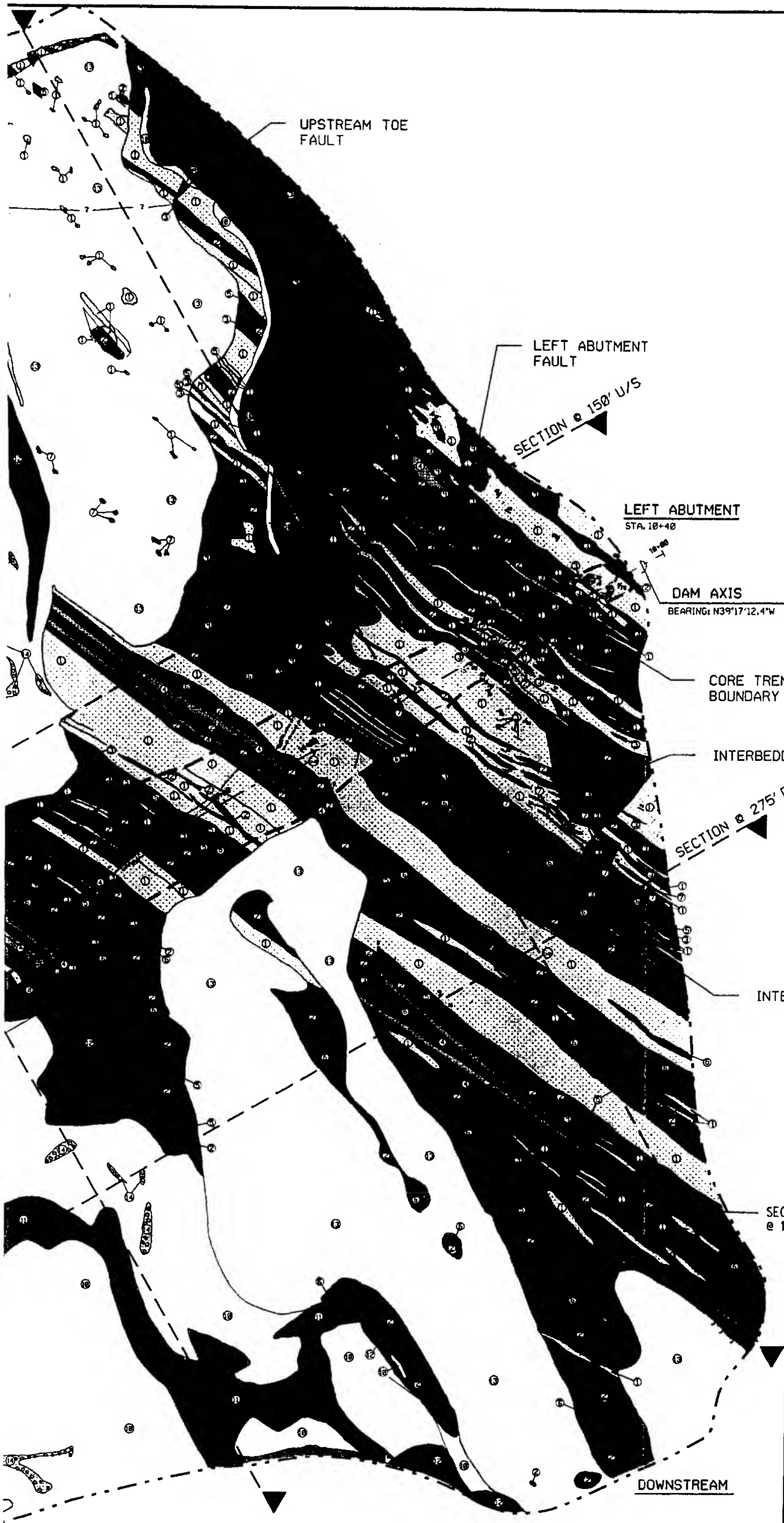
SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	TR. BY	GEOL. BY	FILE No.
ERE		CEC	PLATE 11



UPSTREAM
SECTION
@ 18+00
STATION 17
FAULT
STATION 22
FAULT
CORE TRENCH
BOUNDARY
RIGHT ABUTMENT
STA. 27+90
OLD LANDSLIDE



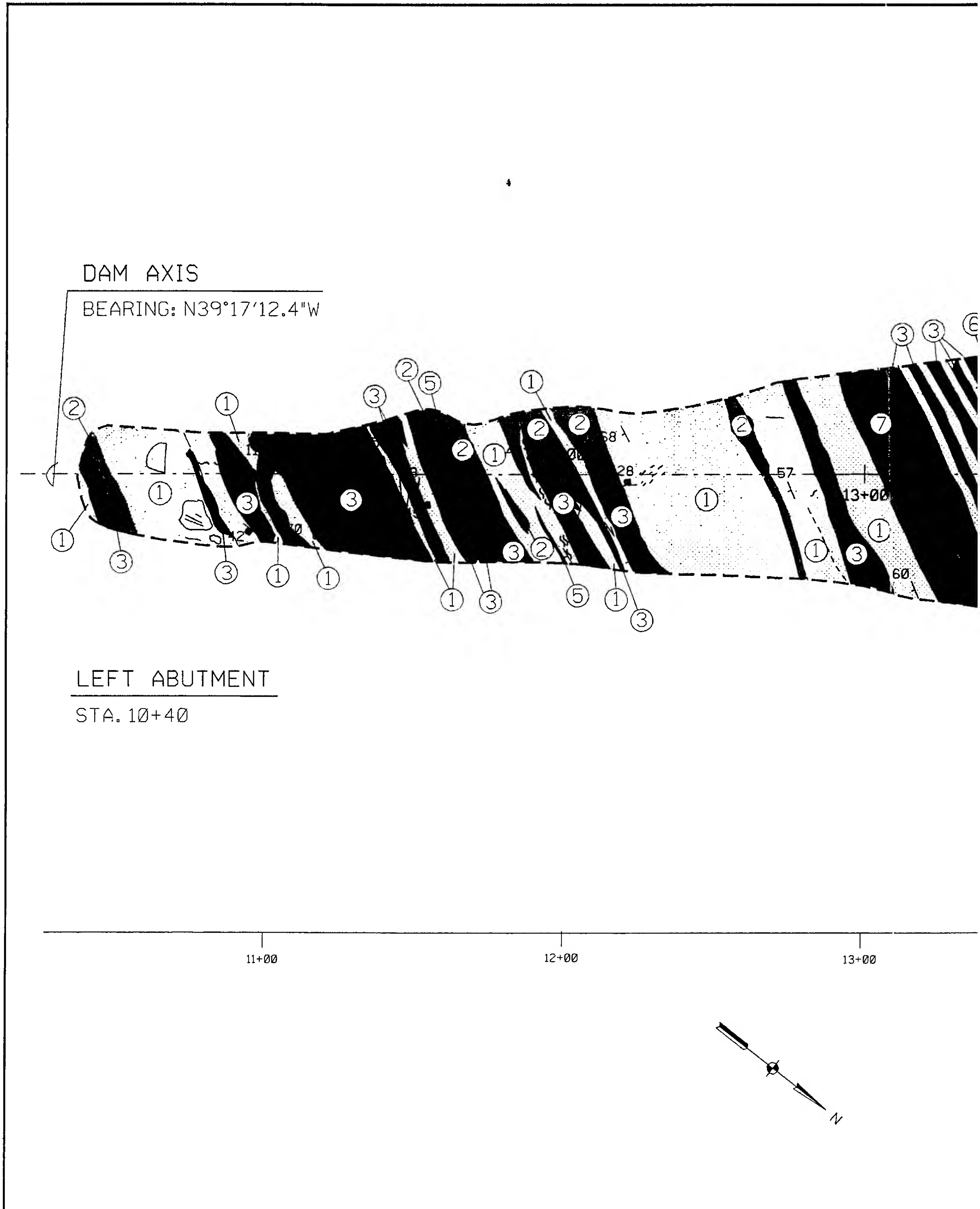
NOTE:
REFERENCE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS AND DESCRIPTIONS

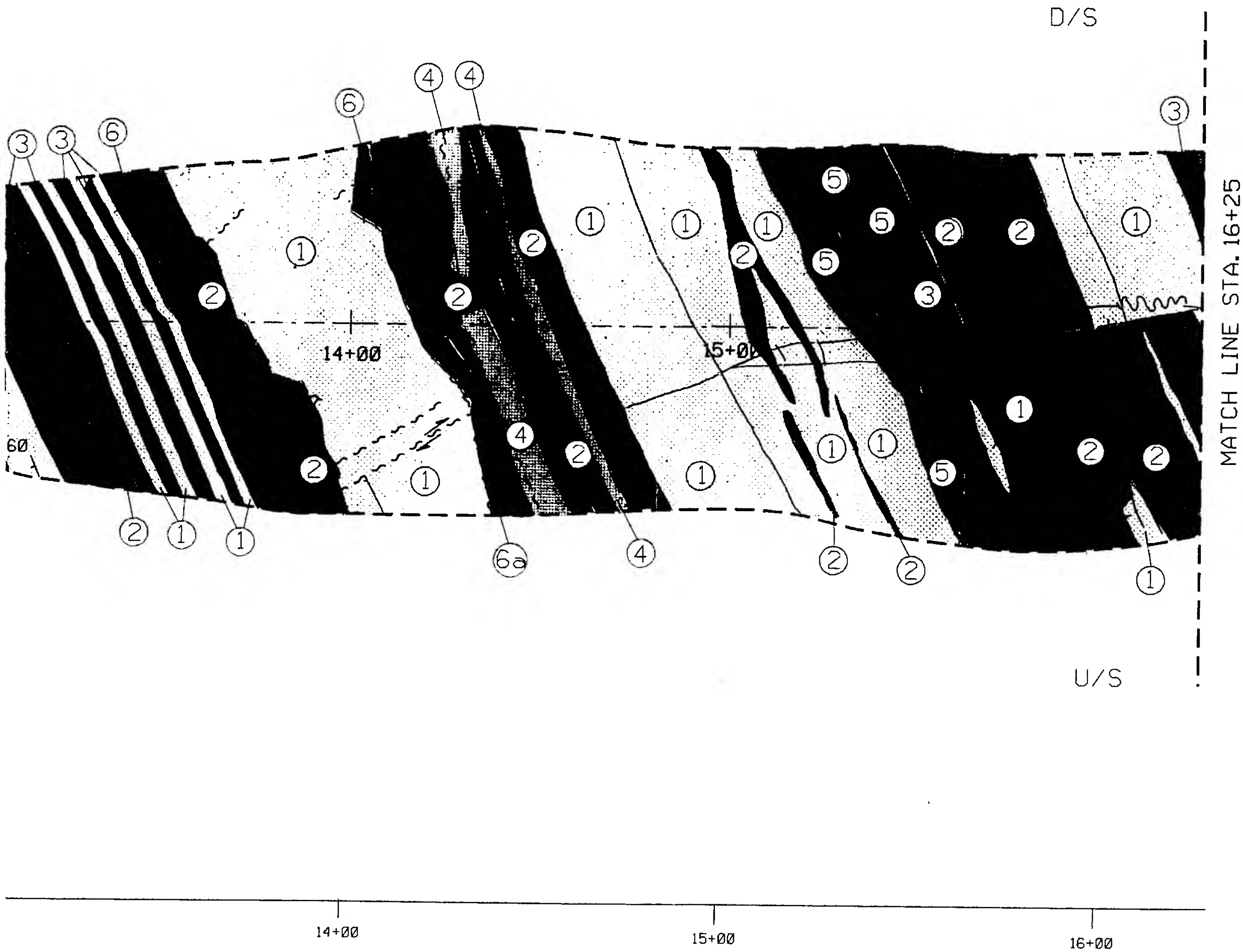
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM
GEOLOGIC MAP
EMBANKMENT FOUNDATION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	TR. BY:	GEOL. BY: CEC	PLATE 12


DAM AXIS
BEARING: N39°17'12.4"W
LEFT ABUTMENT
STA. 10+40
13+00
11+00
12+00
13+00
N



NOTE:

FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11.

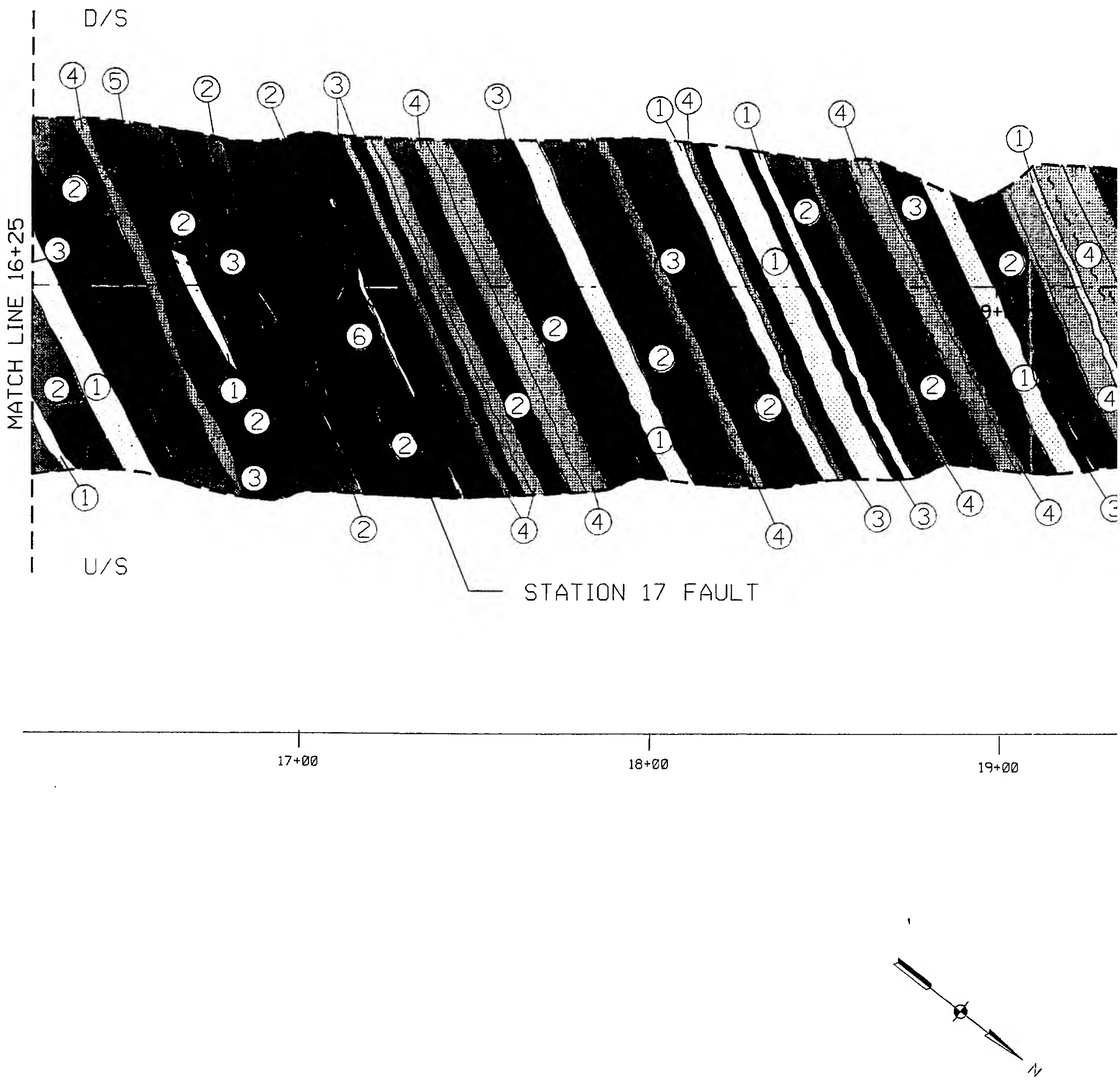
GRAPHIC SCALE:

0 20 40 60 80 100

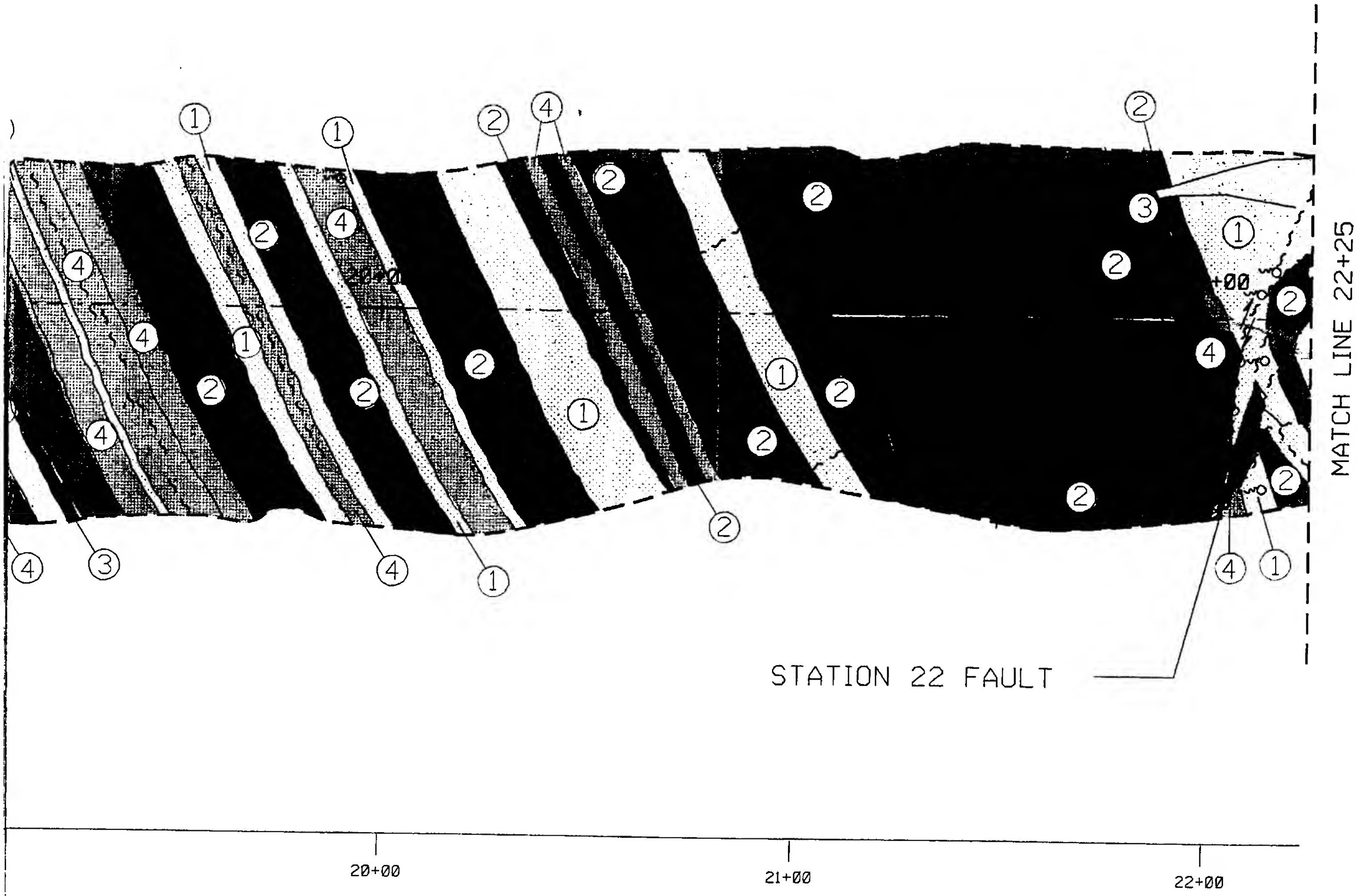
(SCALE IN FEET)

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH
MAIN DAM GEOLOGIC MAP - IMPERVIOUS ZONE STA. 10+40 TO STA. 16+25
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Trust for CARL E. COLE, RESIDENT GEOLOGIST		APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER	
DR. BY: ERE	TR. BY:	GEOL. BY: CEC	FILE No.: PLATE 13



D/S
U/S
MATCH LINE 16+25
STATION 17 FAULT
17+00
18+00
19+00
N



NOTE:

FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11.

GRAPHIC SCALE:

0 20 40 60 80 100

(SCALE IN FEET)

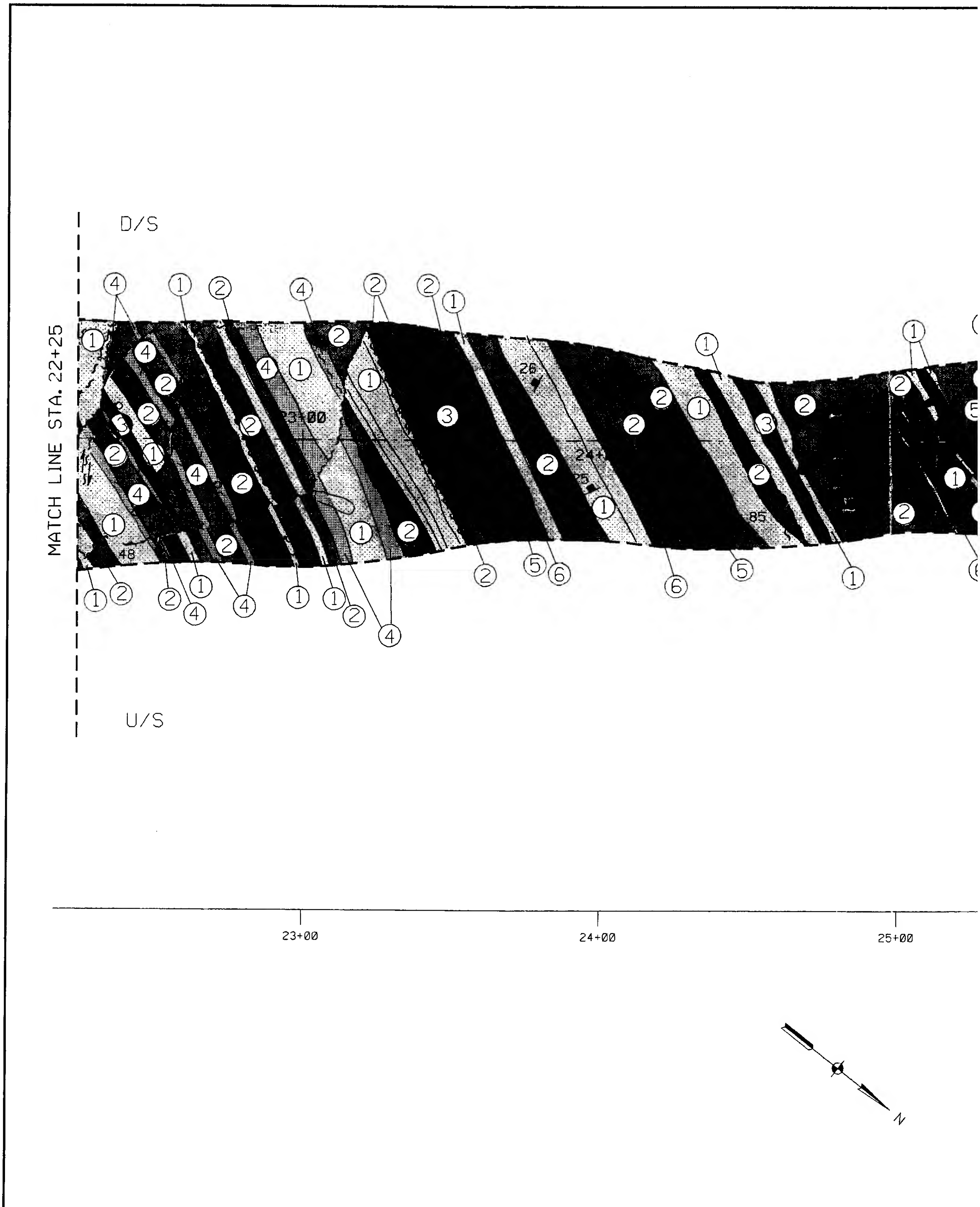
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

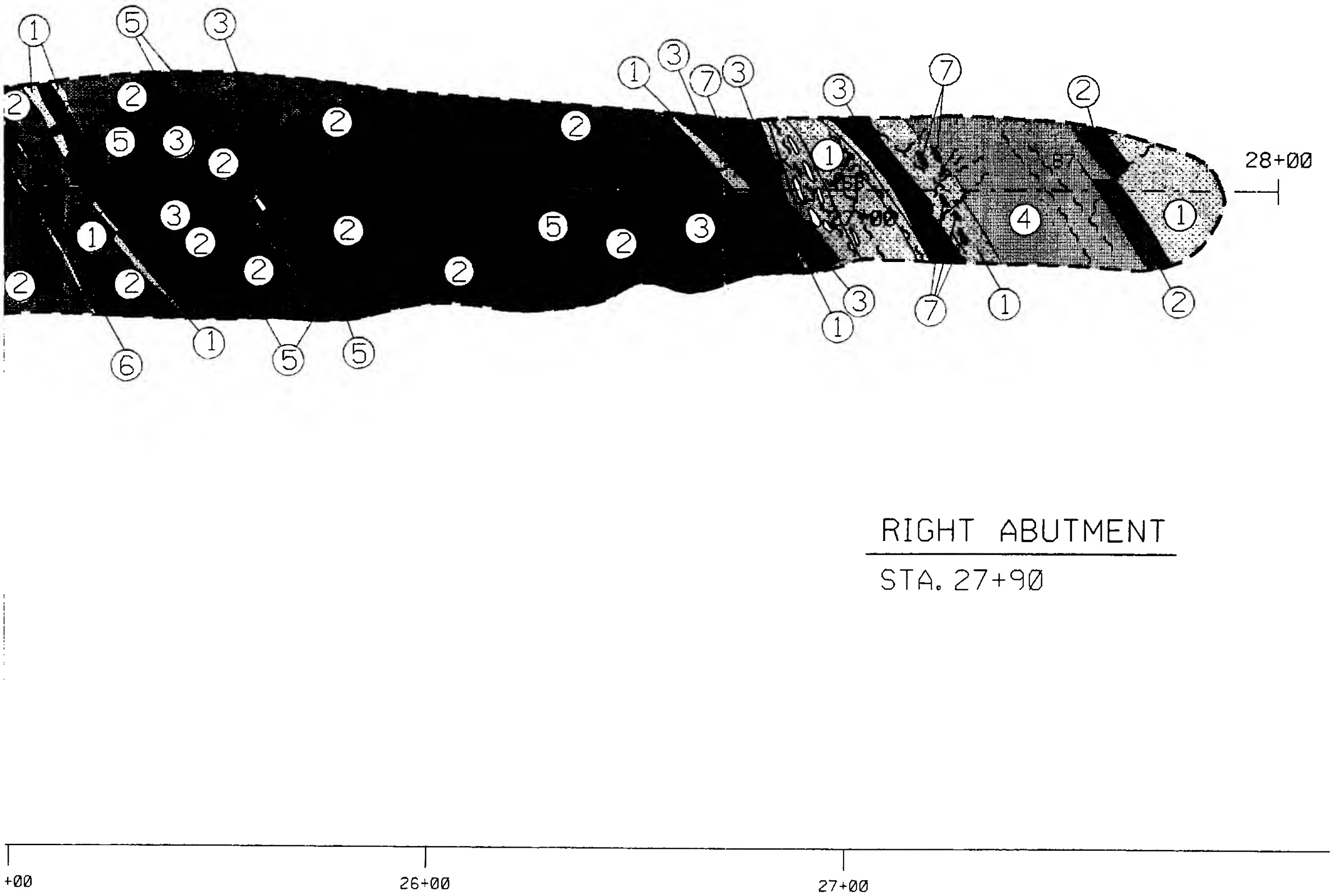
GEOLOGIC MAP - IMPERVIOUS ZONE
STA. 16+25 TO STA. 22+25

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: for John Lang PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	TR. BY:	GEOL. BY: CEC	FILE No: PLATE 14



MATCH LINE STA. 22+25
D/S
U/S
23+00
24+00
25+00
N



NOTE:

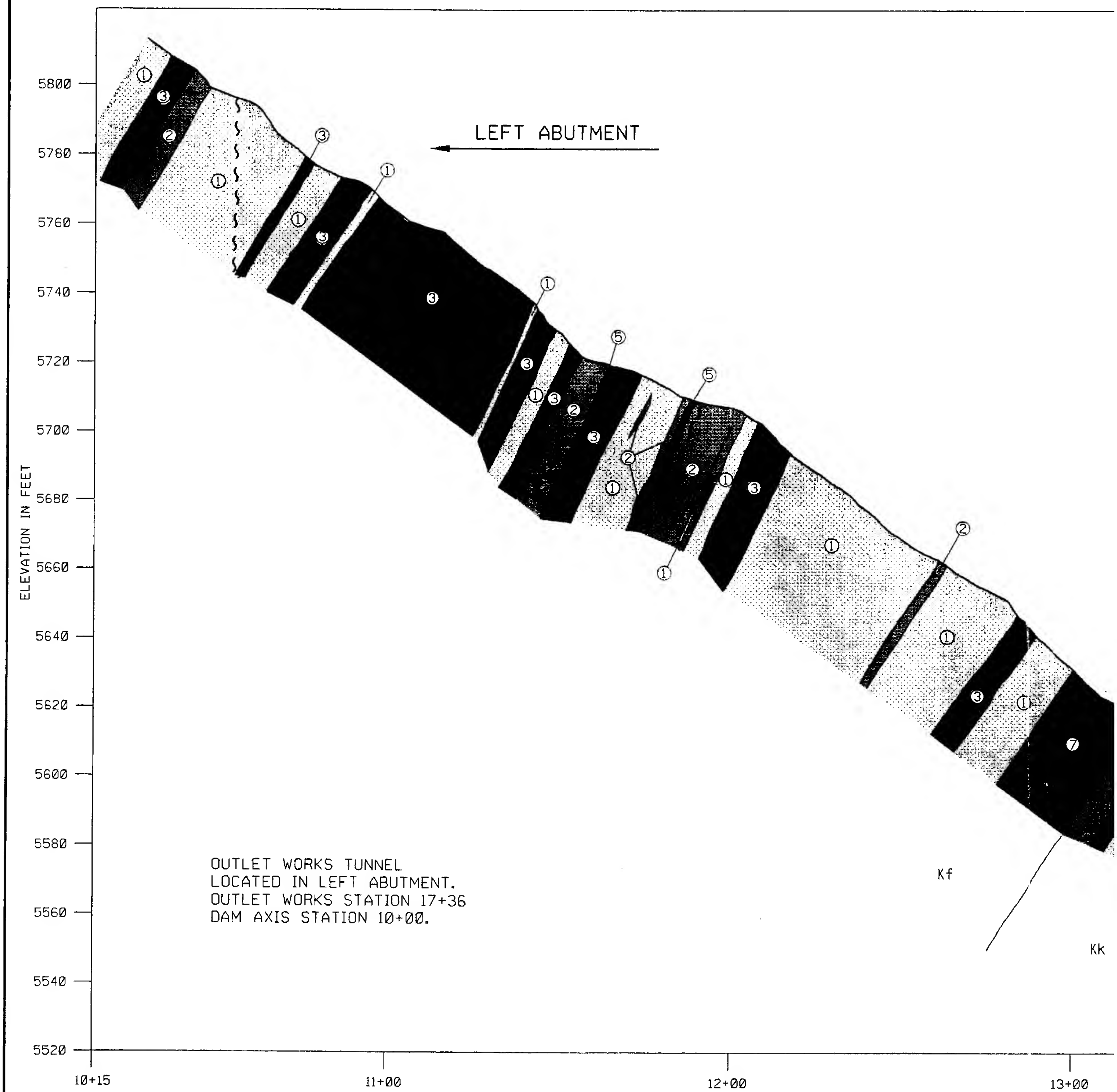
FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11.

GRAPHIC SCALE:

0 20 40 60 80 100

(SCALE IN FEET)

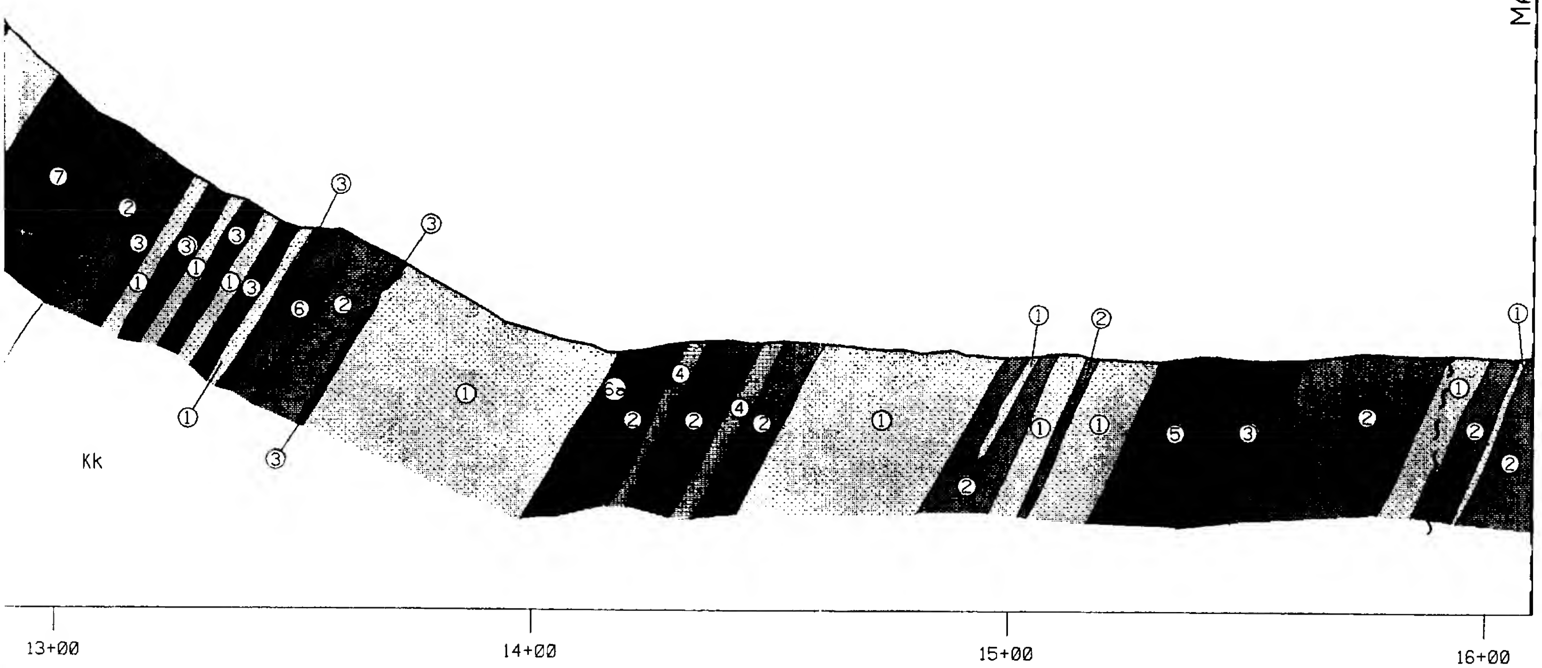
LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH MAIN DAM GEOLOGIC MAP - IMPERVIOUS ZONE STA. 22+25 TO STA. 27+87	
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA	
SUBMITTED: Robert L. Trost for CARL E. COLE RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT RESIDENT ENGINEER
DR. BY: ERE | TR. BY: | GEOL. BY: CEC	FILE No: PLATE 15



LEFT ABUTMENT
ELEVATION IN FEET
5800
5780
5760
5740
5720
5700
5680
5660
5640
5620
5600
5580
5560
5540
5520
10+15
11+00
12+00
13+00
Kf
Kk
OUTLET WORKS TUNNEL
LOCATED IN LEFT ABUTMENT.
OUTLET WORKS STATION 17+36
DAM AXIS STATION 10+00.

NOTES:

1. FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11
2. DAM AXIS BEARING = N39°17'12.4"W
3. TOP OF DAM BETWEEN ELEVATION 5813 FT. AND 5815 FT.



GRAPHIC SCALE:

0 20 40 60 80 100

(SCALE IN FEET)

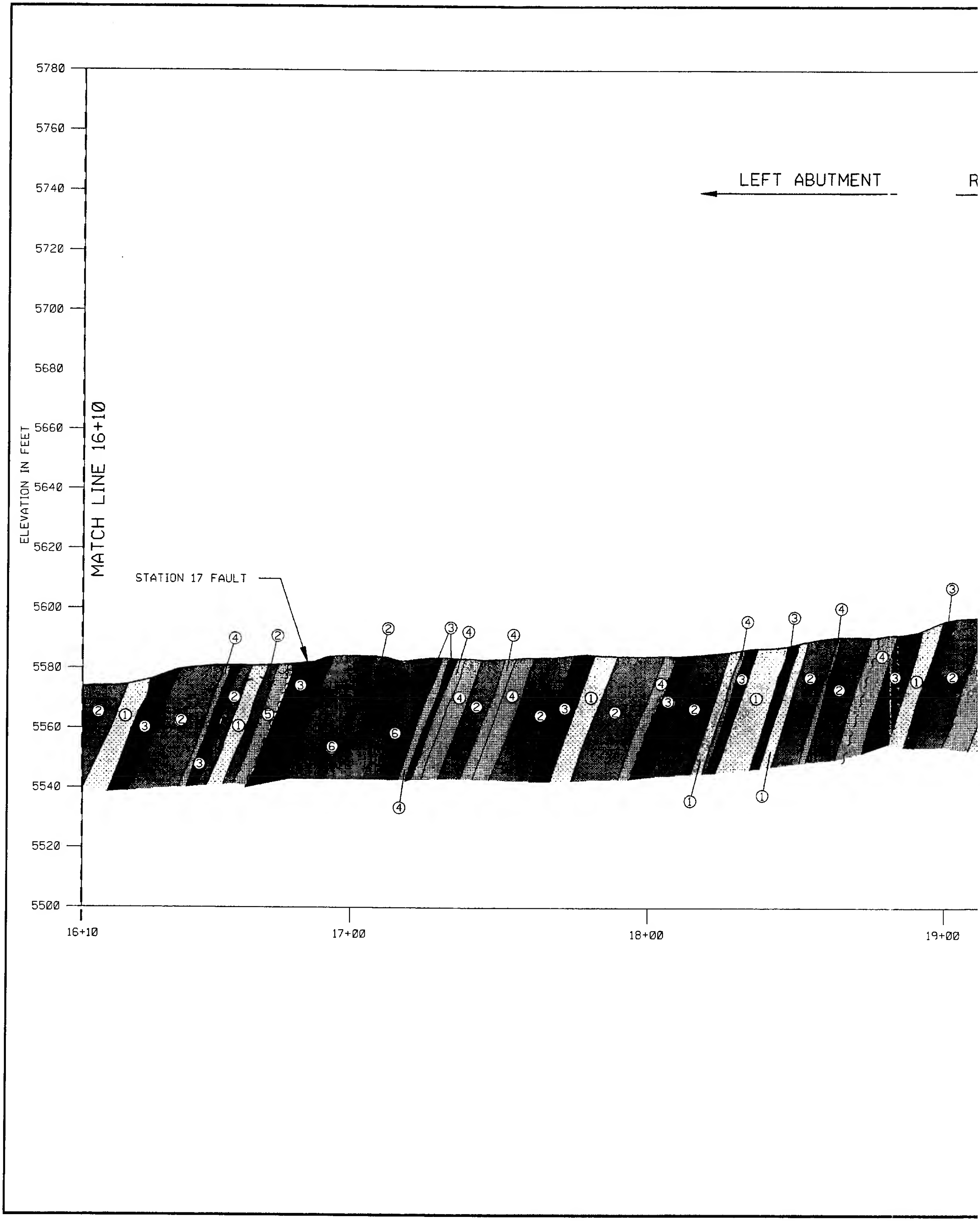
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

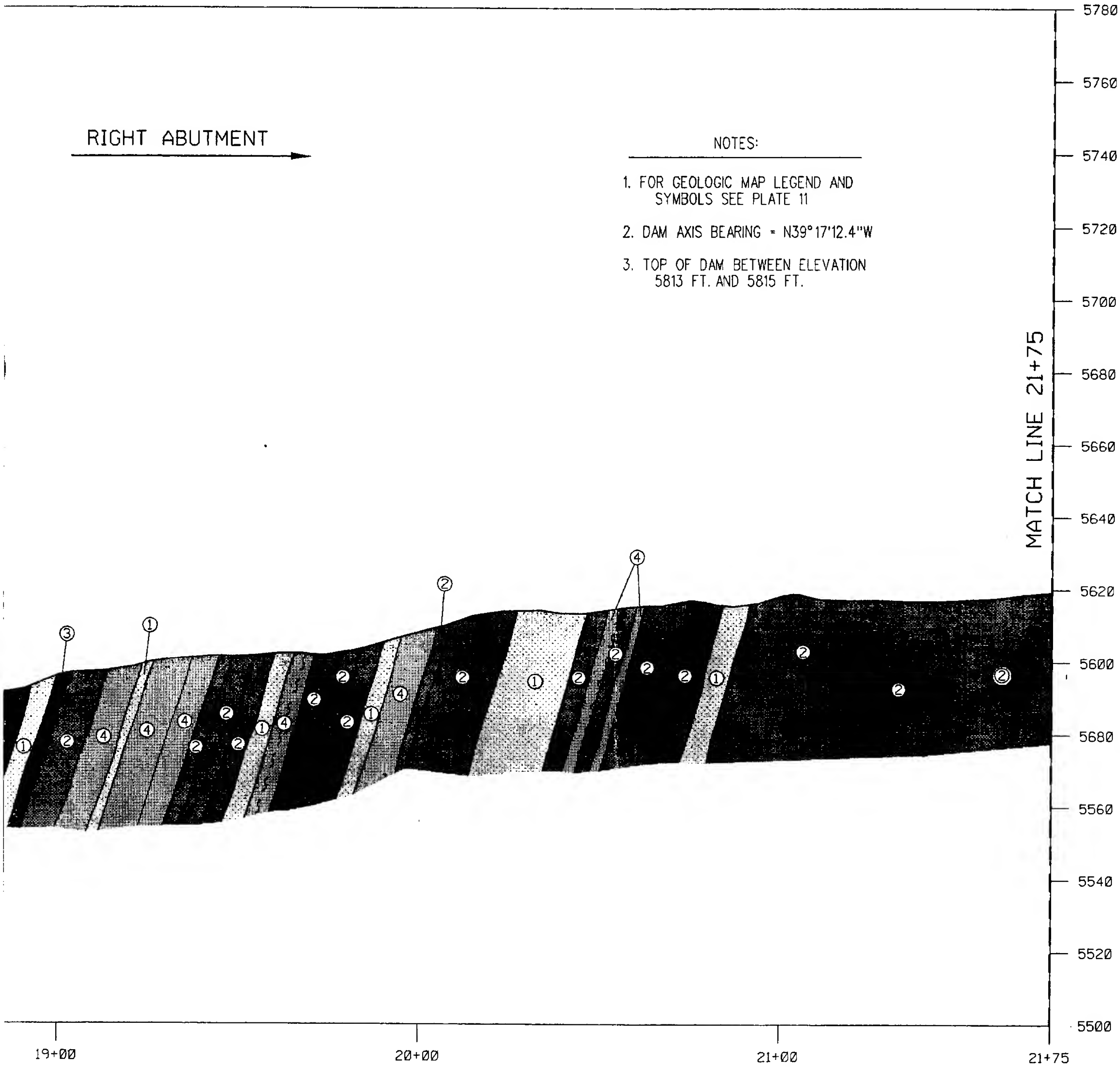
GEOLOGIC SECTION ALONG AXIS OF DAM
STA. 10+15 TO STA. 16+10

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:			APPROVED:
Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST			PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	TR. BY:	GEOL. BY: CEC	FILE No.: PLATE 16



LEFT ABUTMENT
R
MATCH LINE 16+10
STATION 17 FAULT
ELEVATION IN FEET
5780
5760
5740
5720
5700
5680
5660
5640
5620
5600
5580
5560
5540
5520
5500
16+10
17+00
18+00
19+00



NOTES:

1. FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11
2. DAM AXIS BEARING = N39°17'12.4"W
3. TOP OF DAM BETWEEN ELEVATION 5813 FT. AND 5815 FT.

GRAPHIC SCALE:

0 20 40 60 80 100

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

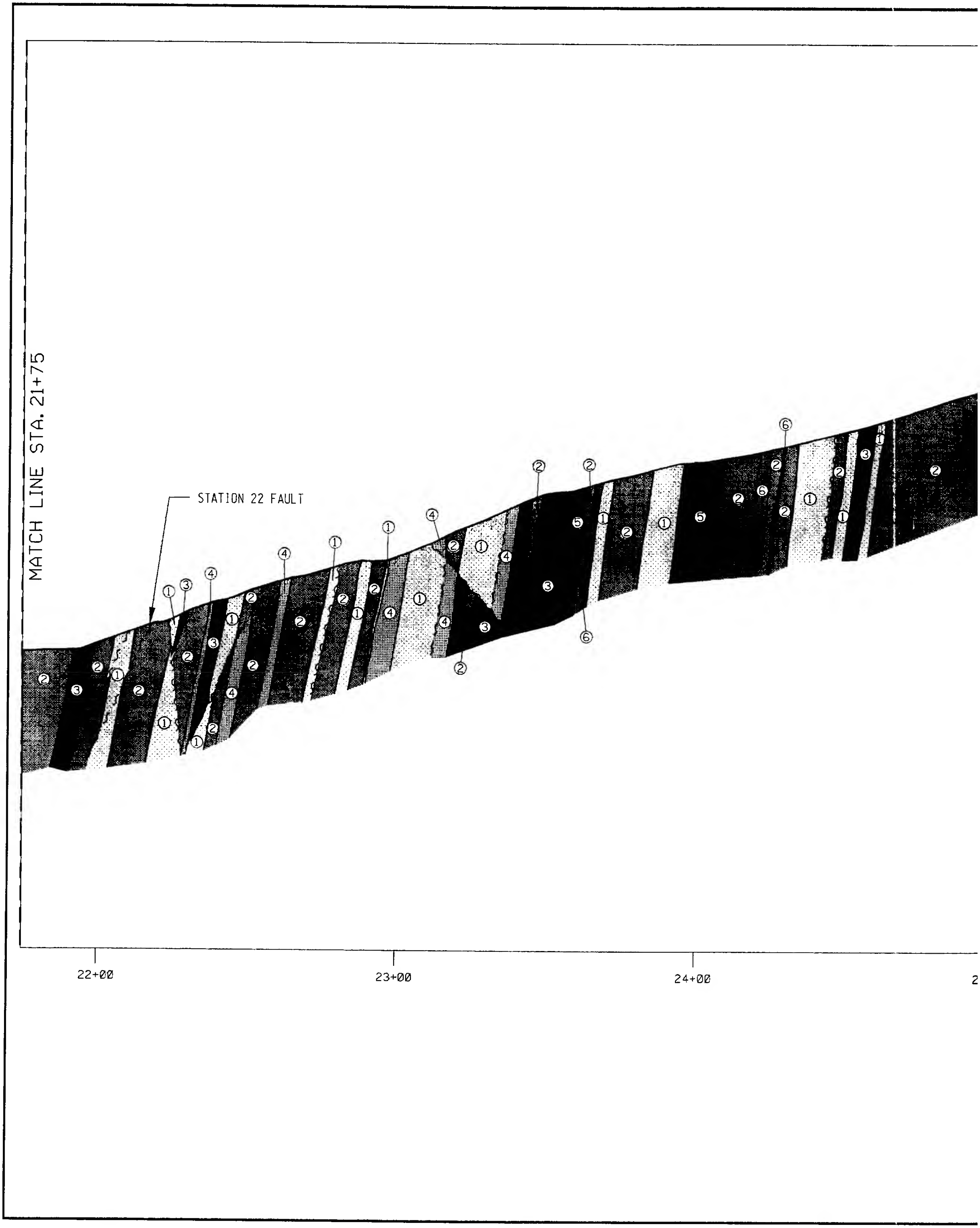
MAIN DAM

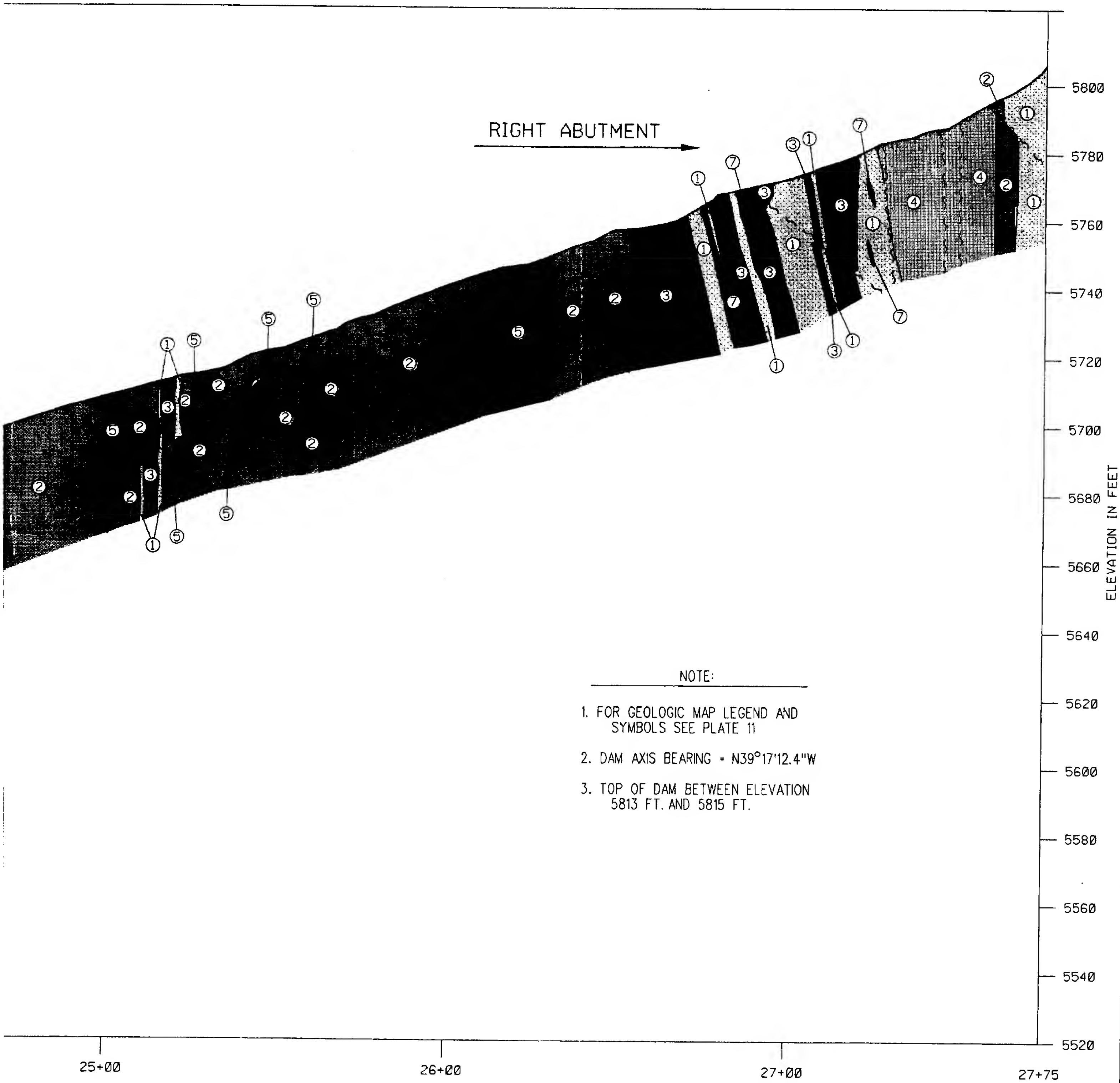
GEOLOGIC SECTION ALONG AXIS OF DAM
STA. 16+10 TO STA. 21+75

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	GEOL. BY:	FILE No.:
ERE		CEC	PLATE 17


MATCH LINE STA. 21+75
STATION 22 FAULT
22+00
23+00
24+00



NOTE:

1. FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11
2. DAM AXIS BEARING = N39°17'12.4"W
3. TOP OF DAM BETWEEN ELEVATION 5813 FT. AND 5815 FT.

GRAPHIC SCALE:

0 20 40 60 80 100

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

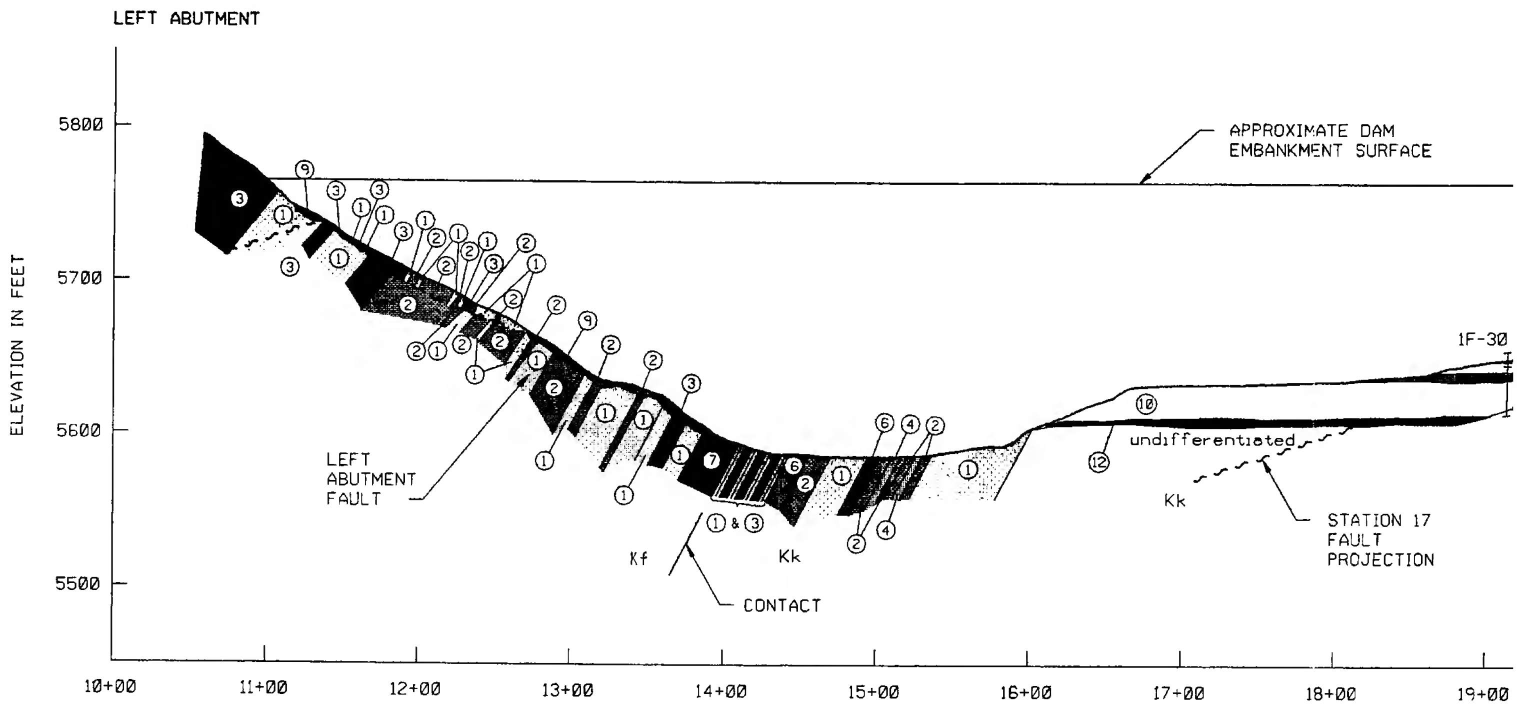
MAIN DAM

GEOLOGIC SECTION ALONG AXIS OF DAM
STA. 21+75 TO STA. 27+75

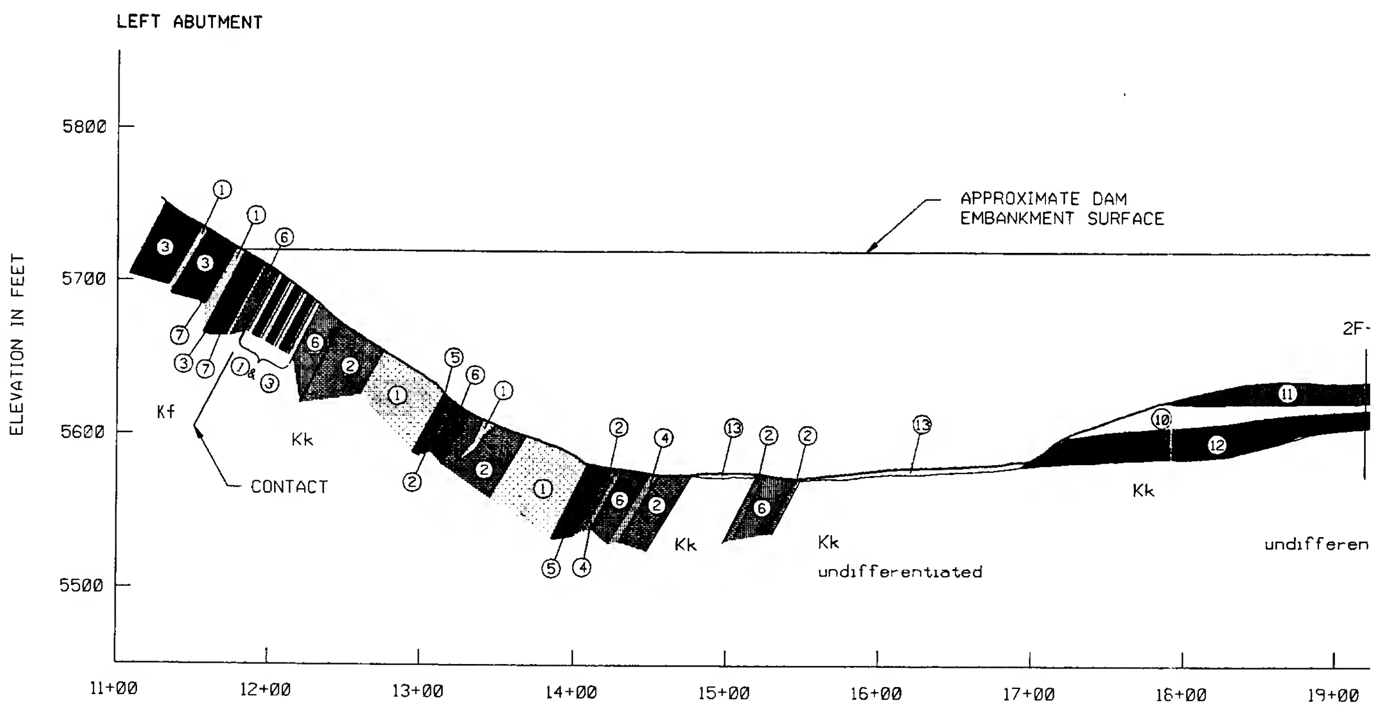
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

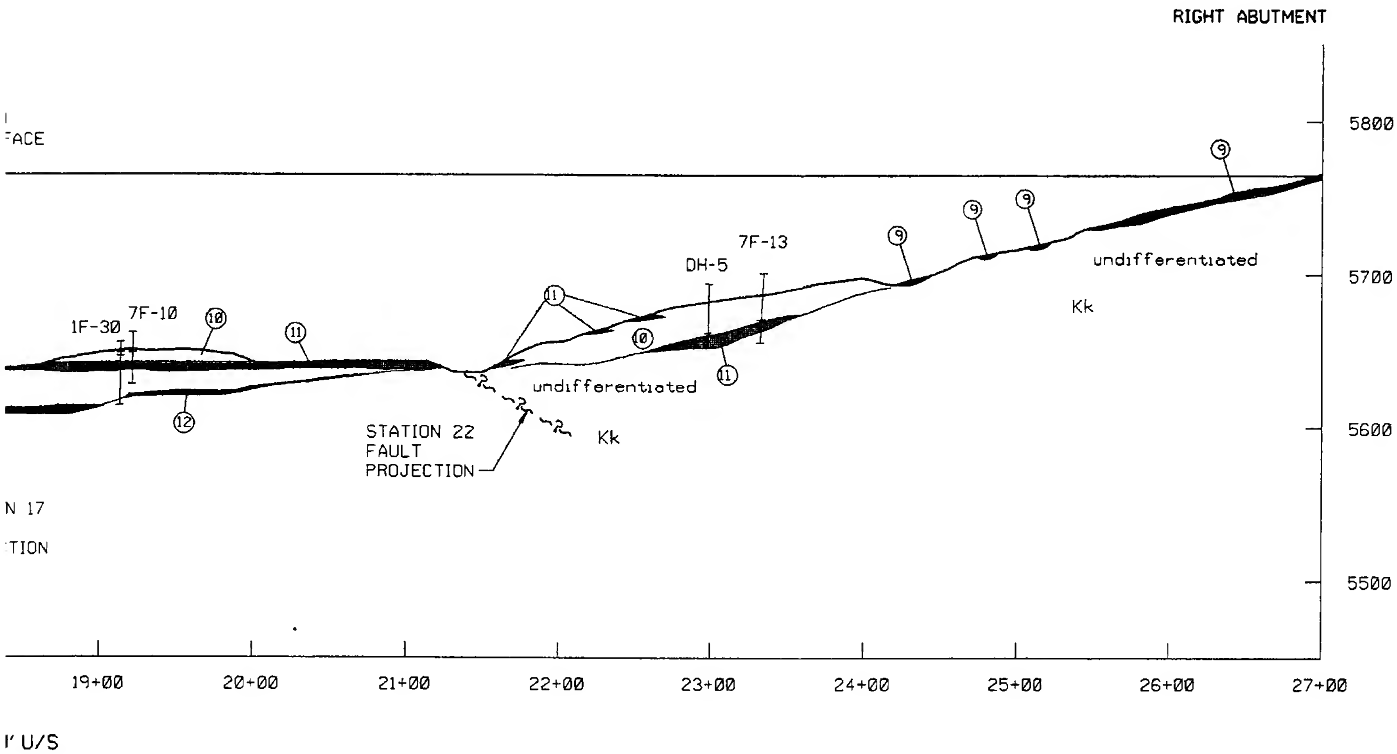
DR. BY:	TR. BY:	GEOL. BY:	FILE No:
ERE		CEC	PLATE 18

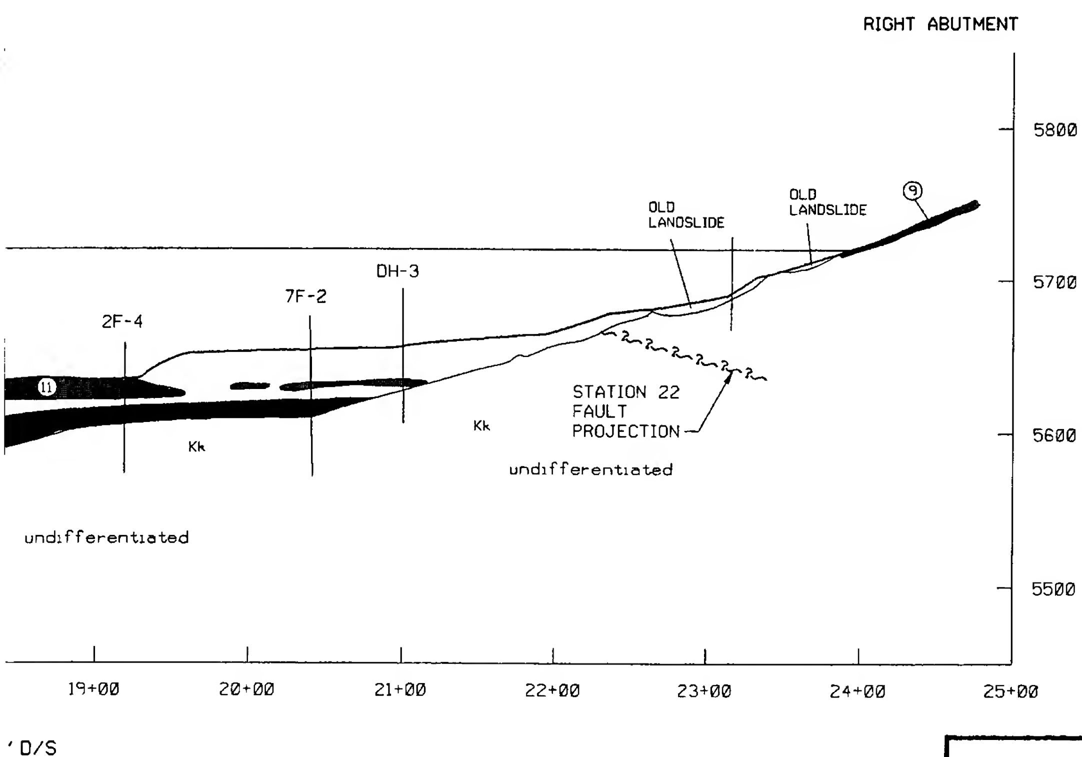


SECTION AT 150' U/S



SECTION AT 275' D/S





NOTE:

FOR GEOLOGIC MAP LEGEND AND SYMBOLS SEE PLATE 11.

GRAPHIC SCALE:

0 125' 250'

(SCALE IN FEET)

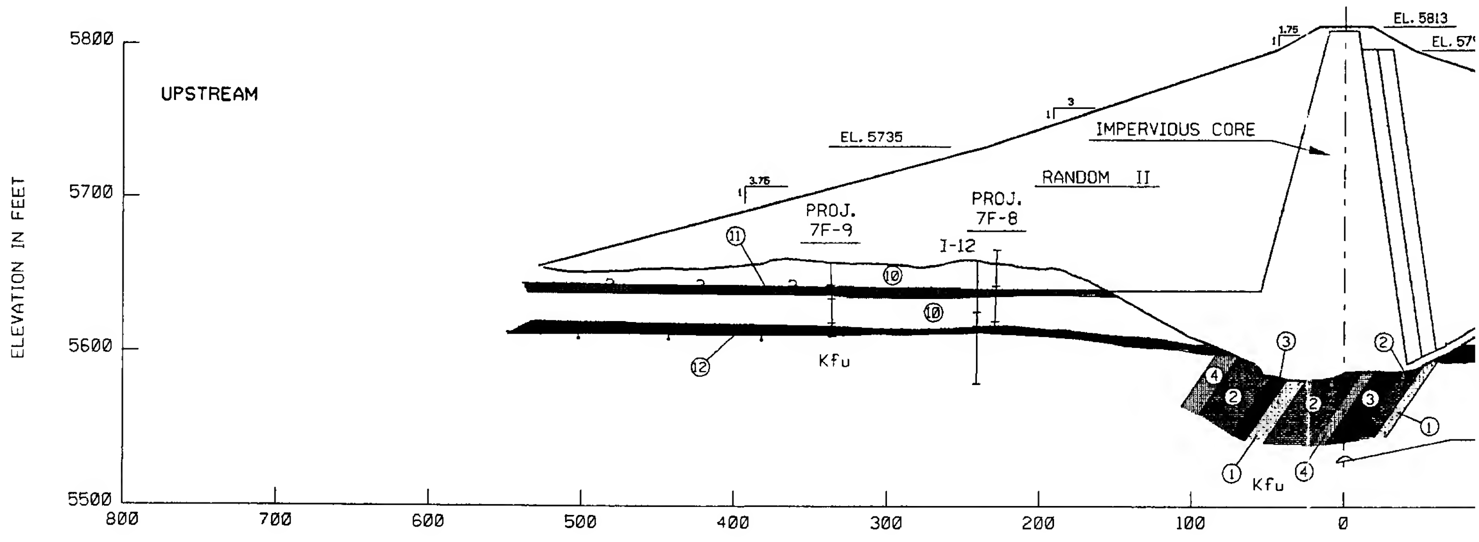
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

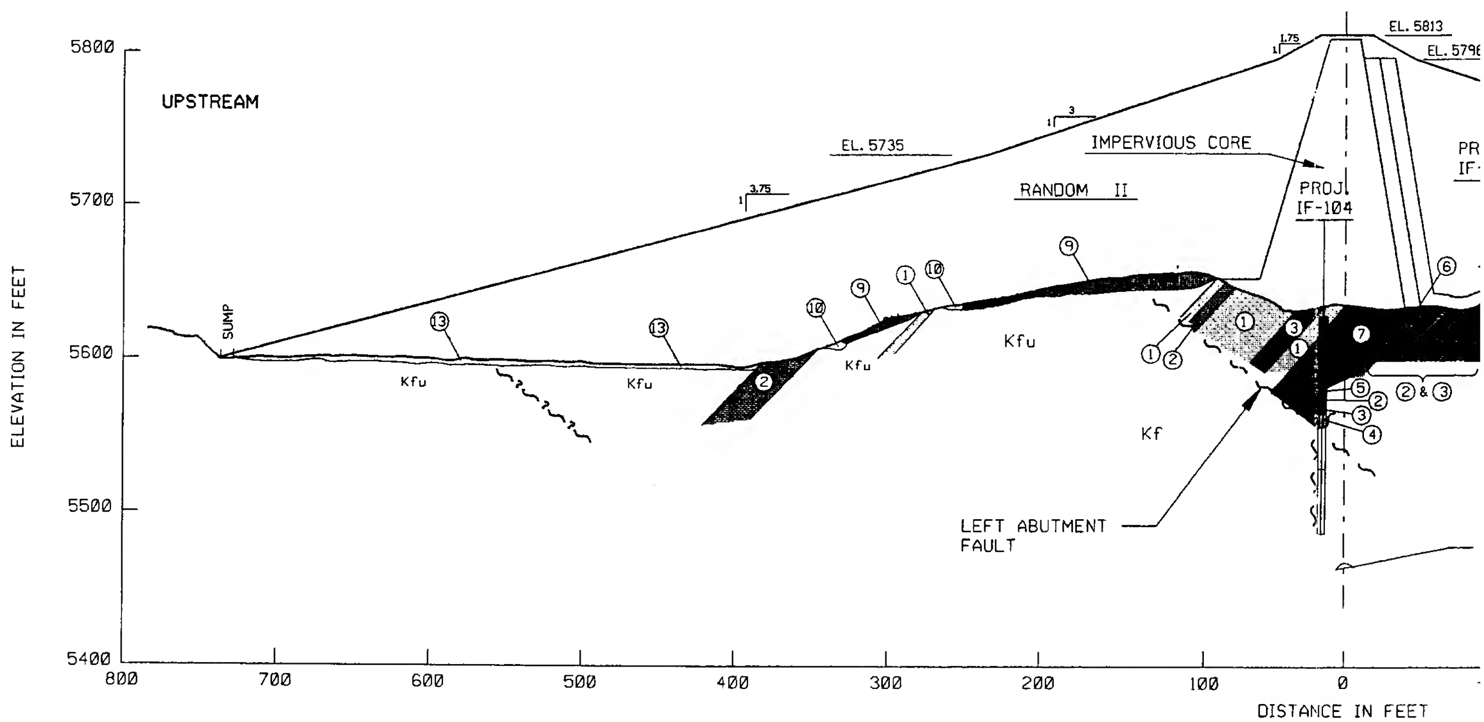
GEOLOGIC SECTIONS PARALLEL TO AXIS AT 275' D/S AND AT 150' U/S

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

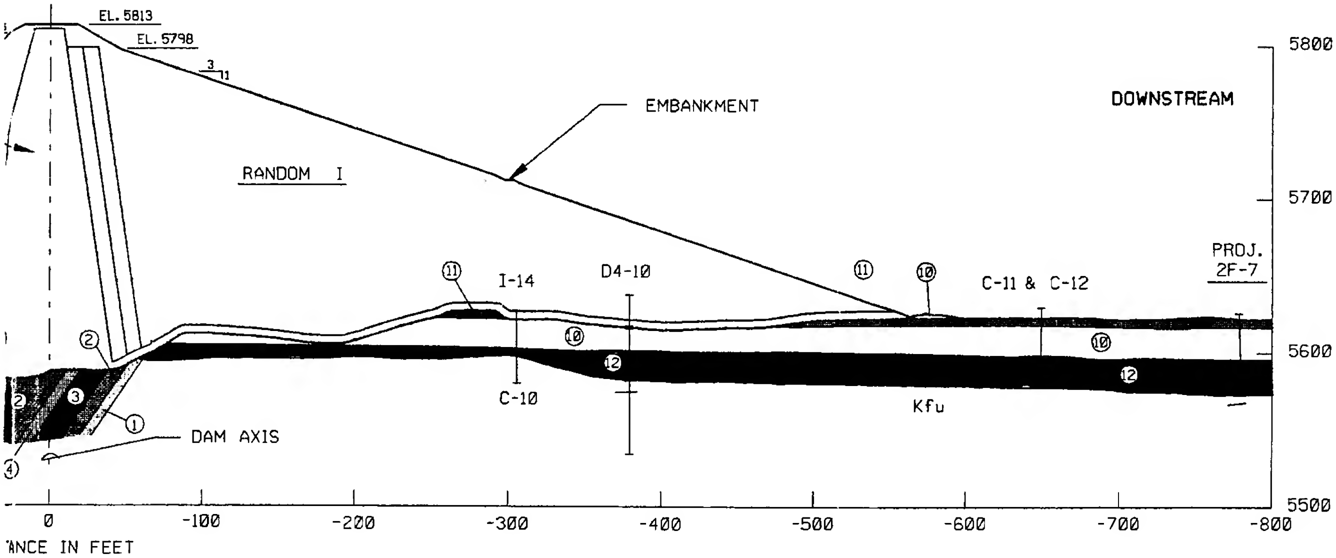
SUBMITTED:			APPROVED:
Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST			PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	TR. BY:	GEOL. BY: CEC	FILE No.: PLATE 19



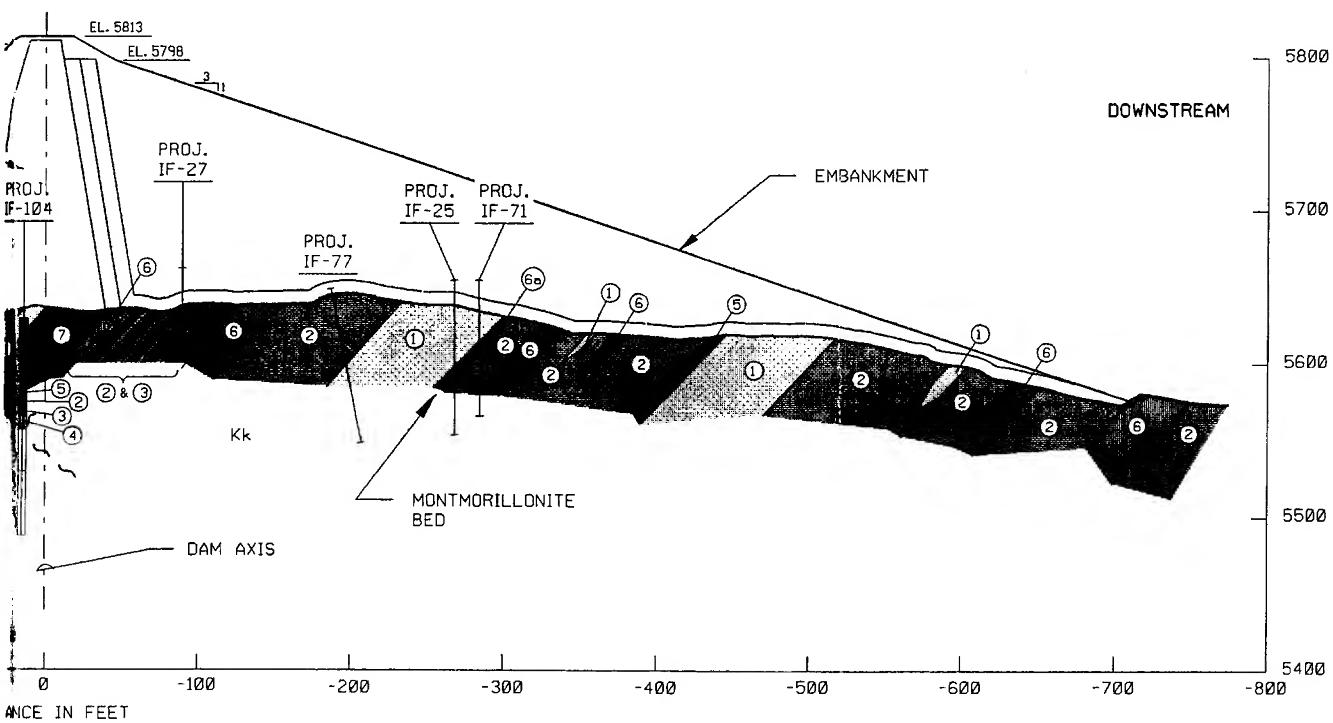
SECTION ALONG STA. 18+00



SECTION ALONG STA. 13+00



ALONG STA. 18+00



ALONG STA. 13+00

NOTE:

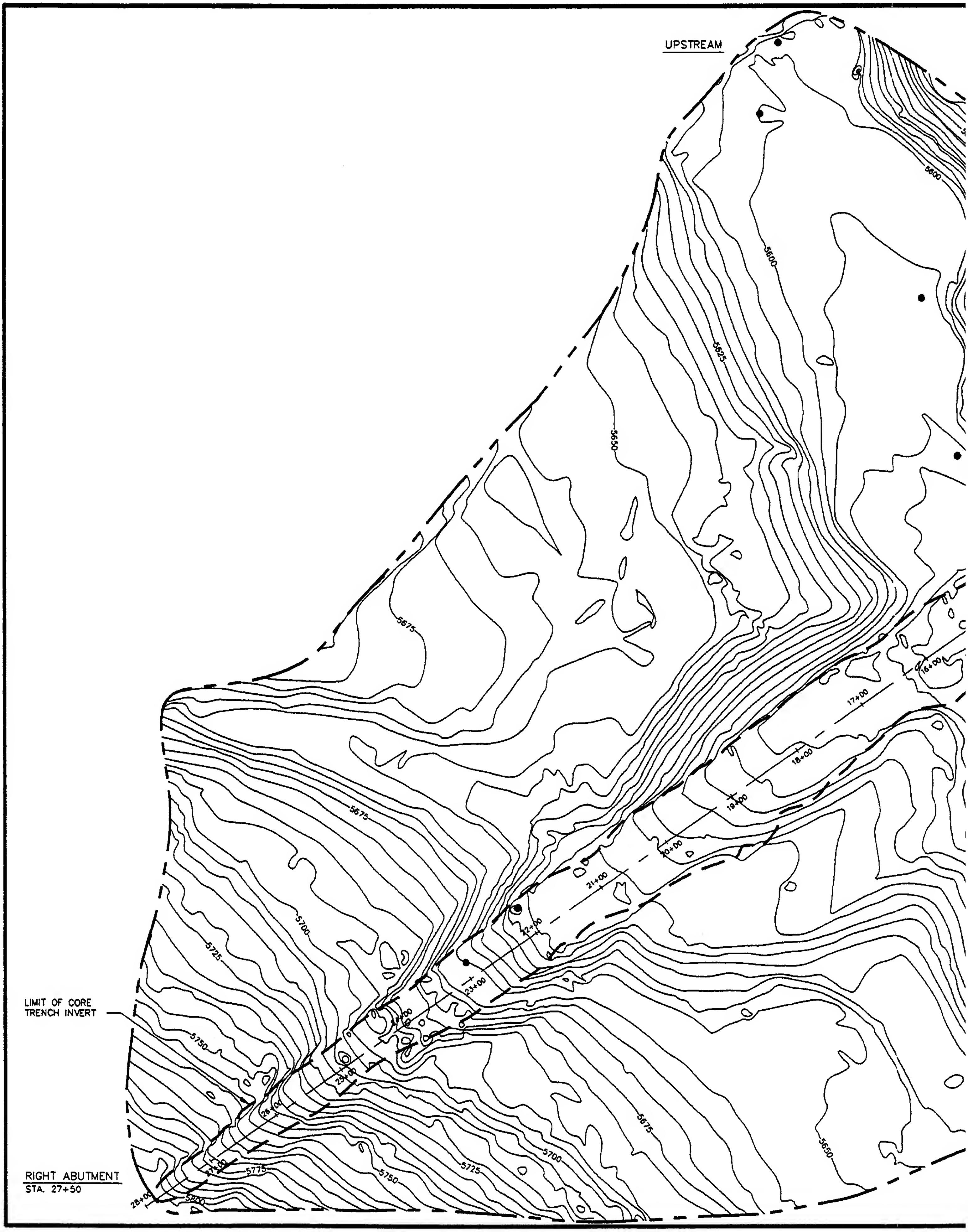
FOR GEOLOGIC MAP NLEGEND AND SYMBOLS SEE PLATE 11.

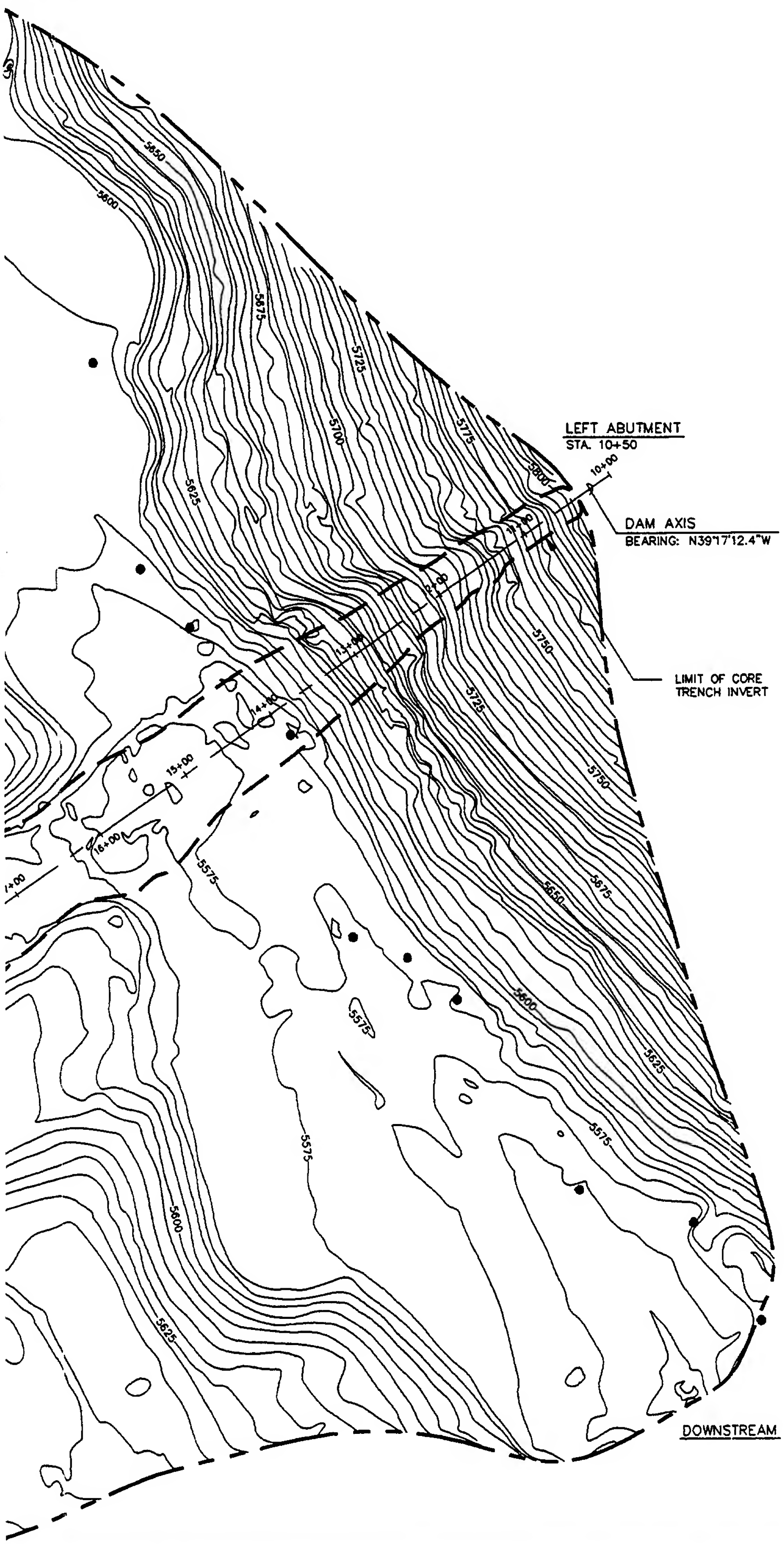
GRAPHIC SCALE:

0 125' 250'

(SCALE IN FEET)

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH MAIN DAM GEOLOGIC SECTION PERPENDICULAR TO AXIS AT STA. 13+00 AND STA. 18+00	
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA	
SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE / TR. BY: / GEOL. BY: CEC	FILE No.: / PLATE 20


UPSTREAM
LIMIT OF CORE
TRENCH INVERT
RIGHT ABUTMENT
STA. 27+50
5600
5625
5650
5675
5700
5725
5750
5775
5800
16+00
17+00
18+00
19+00
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00



GENERAL NOTES:

1. TOPOGRAPHY DEVELOPED FROM CONTRACTOR SUPPLIED DATA DATED SEPT. 1993, BASED ON NCVD OF 1929.
2. TOPOGRAPHY PRODUCED BY U.S. ARMY CORPS OF ENGINEERS ON INTERGRAPH.
3. ELEVATIONS REFER TO MEAN SEA LEVEL DATUM.

LEGEND:

● SUMP LOCATION

GRAPHIC SCALE:

0 50' 100' 150' 200' 250'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

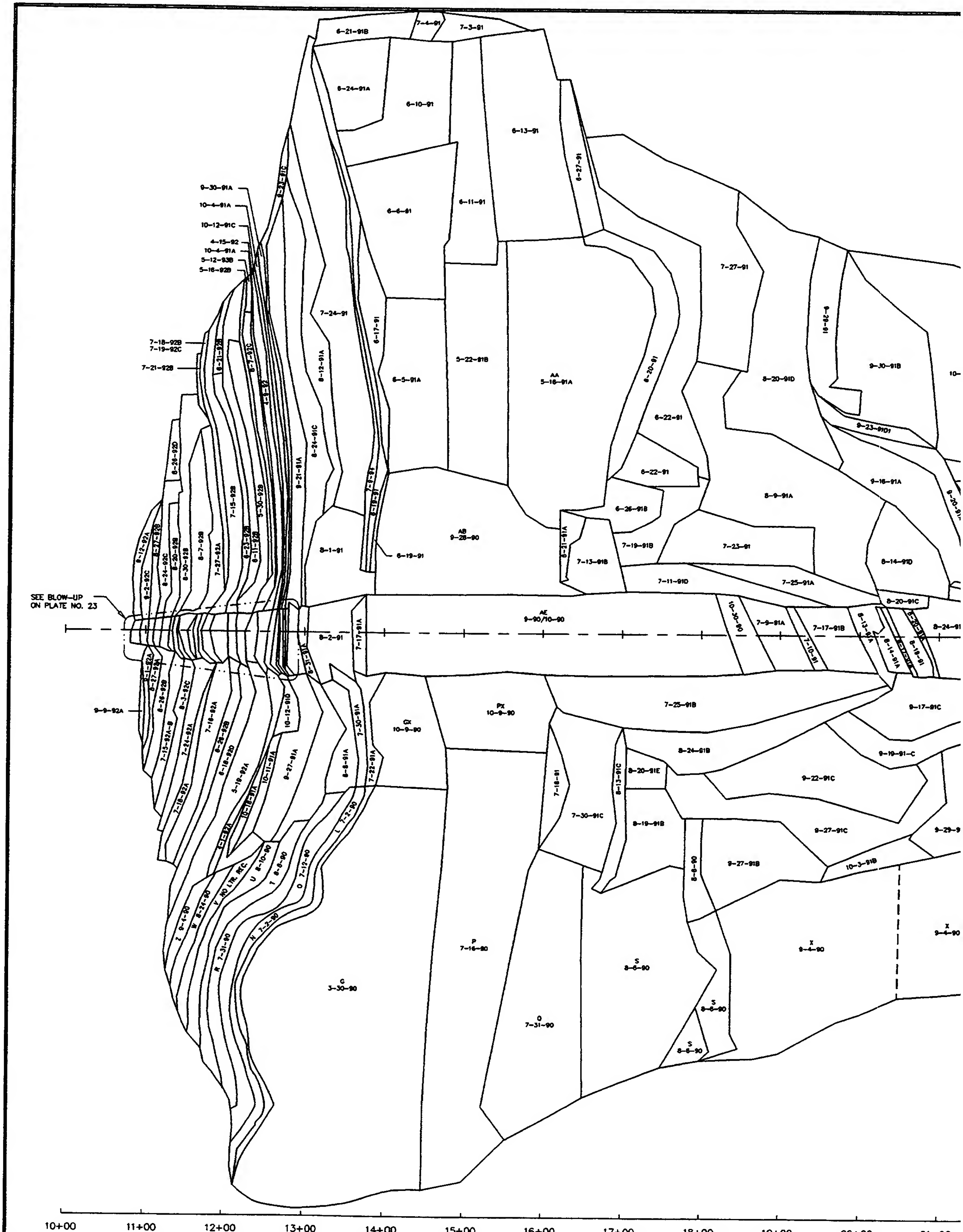
MAIN DAM
CONTOUR MAP
EMBANKMENT FOUNDATION

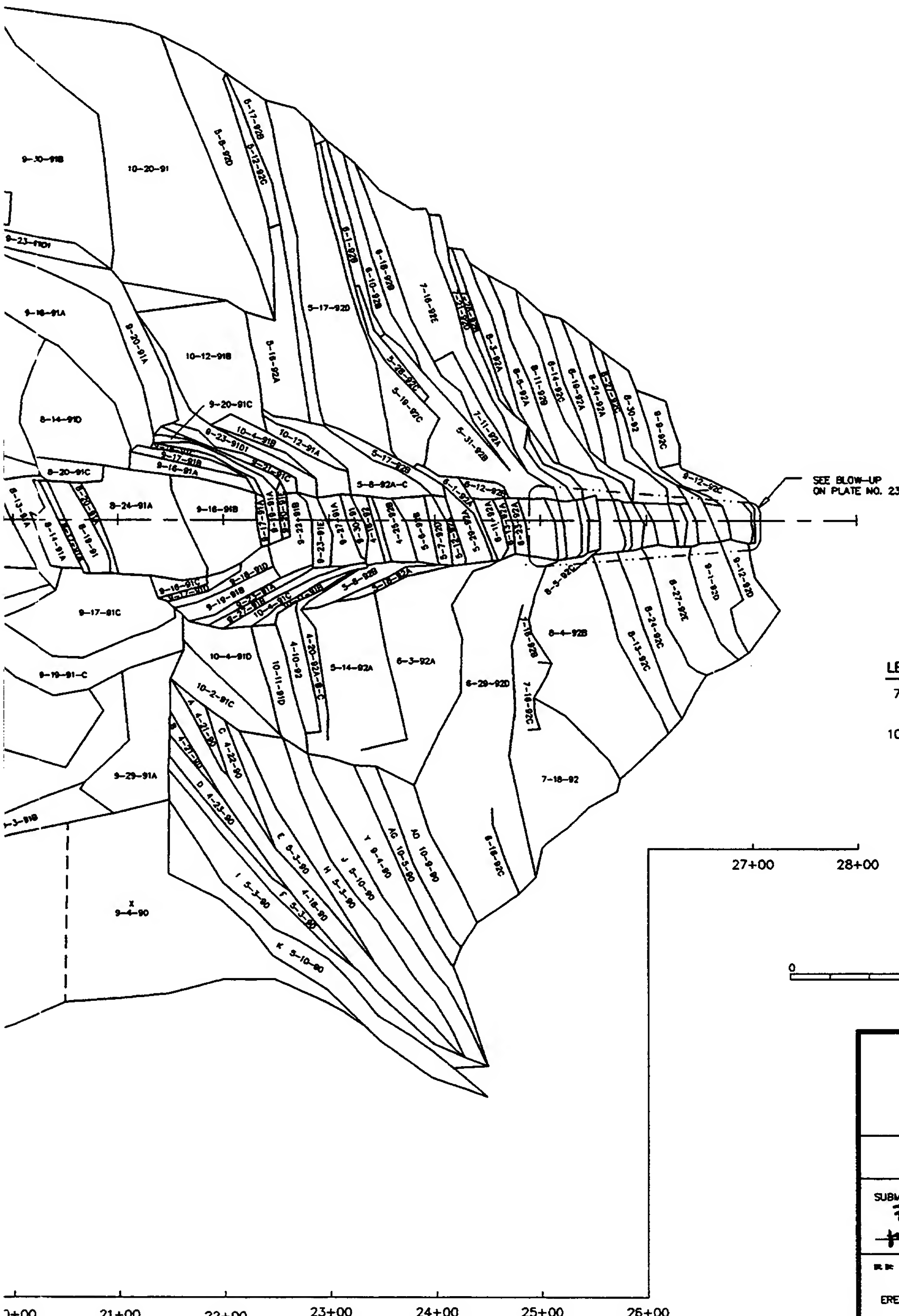
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: per John Lanigan PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CHK. BY:	FILE No.
ERE		CEC	PLATE 21


SEE BLOW-UP ON PLATE NO. 23
6-21-91B
7-4-91
7-3-91
6-24-91A
6-10-91
6-13-91
6-27-91
6-6-91
6-11-91
7-27-91
7-24-91
6-17-91
5-22-91B
AA 5-16-91A
8-20-91
8-20-91D
9-30-91B
6-5-91A
6-22-91
9-23-91D
9-16-91A
8-9-91A
AB 9-28-90
6-26-91B
7-19-91B
7-23-91
8-14-91D
7-13-91B
7-11-91D
7-25-91A
8-20-91C
AE 9-90/10-90
7-9-91A
7-17-91B
8-24-91
8-1-91
8-2-91
6-19-91
7-25-91B
9-17-91C
GX 10-9-90
PX 10-9-90
8-24-91B
9-19-91-C
9-22-91C
8-20-91E
7-30-91C
8-19-91B
9-27-91C
9-27-91B
10-3-91B
X 9-4-90
P 7-16-90
S 8-6-90
O 7-31-90
G 3-30-90
9-9-92A
9-30-91A
10-4-91A
10-12-91C
4-15-92
10-4-91A
5-12-93B
5-16-92B
7-18-92B
7-19-92C
7-21-92B
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00
20+00
21+00



LEGEND:

7-18-92	AREA APPROVED FOR FILL PLACEMENT ON 18 JUL. 1992
10-12-91B	SECOND AREA APPROVED FOR FILL PLACEMENT ON 12 OCT. 1991

GRAPHIC SCALE:

0 150' 300' 450'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

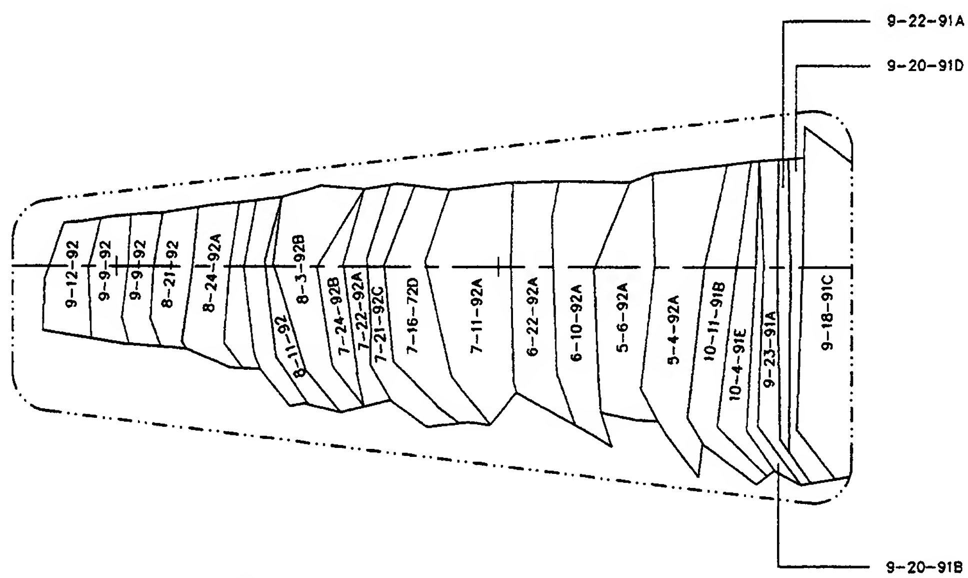
MAIN DAM
FOUNDATION APPROVAL MAP
EMBANKMENT FOUNDATION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

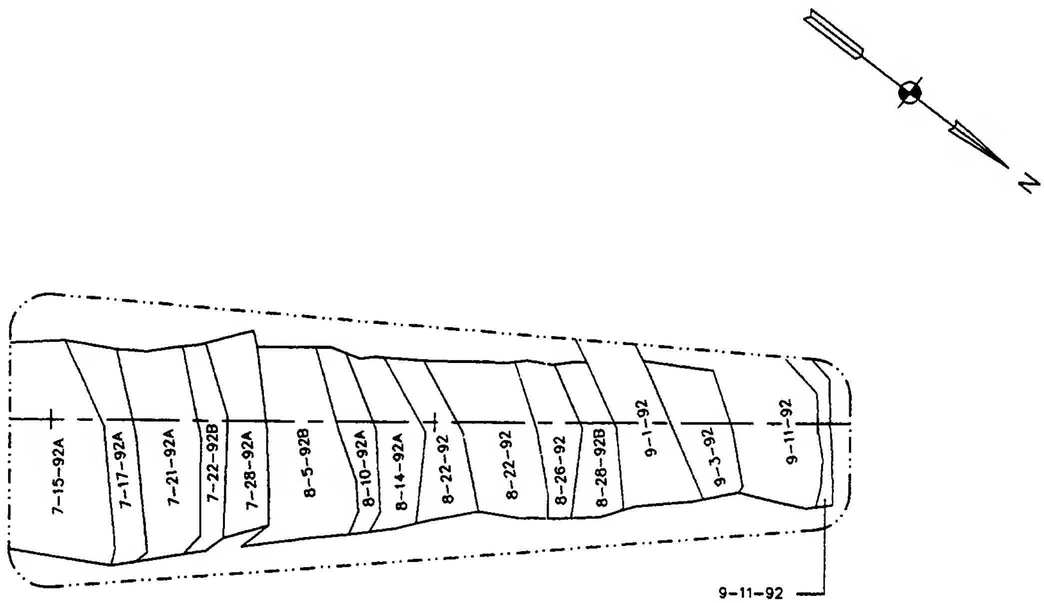
SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: for [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CK. BY:	GEOL. BY:	FILE NO.:
ERE		BAB	PLATE 22



STA. 10+80 TO STA. 12+95



STA. 24+87 TO STA. 27+10

NOTE:

SEE LEGEND ON PLATE 22

GRAPHIC SCALE:

0 50' 100' 150'

(SCALE IN FEET)

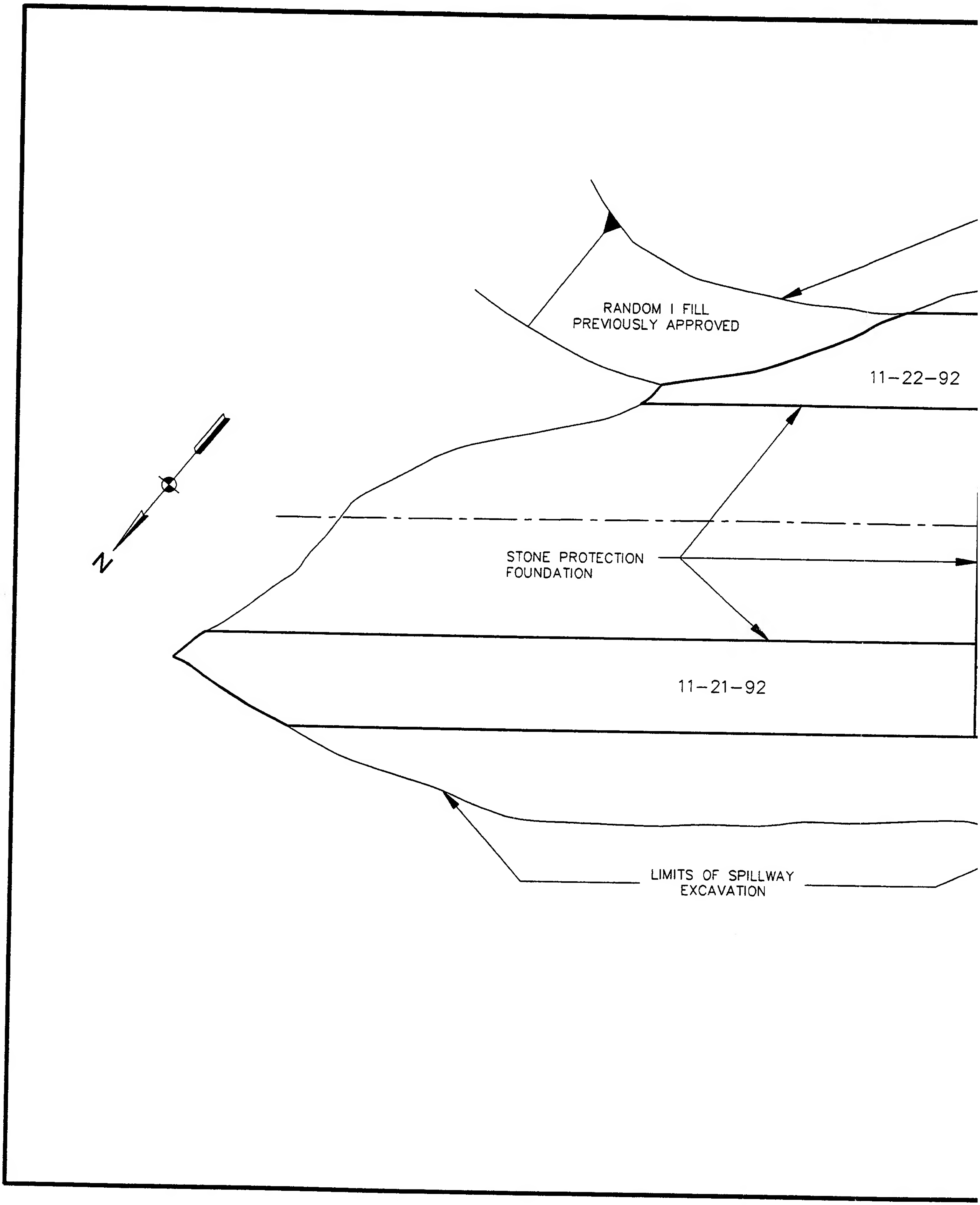
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
MAIN DAM

FOUNDATION APPROVAL MAP
EMBANKMENT FOUNDATION
STA. 10+80 TO 12+95 AND STA. 24+87 TO 27+10

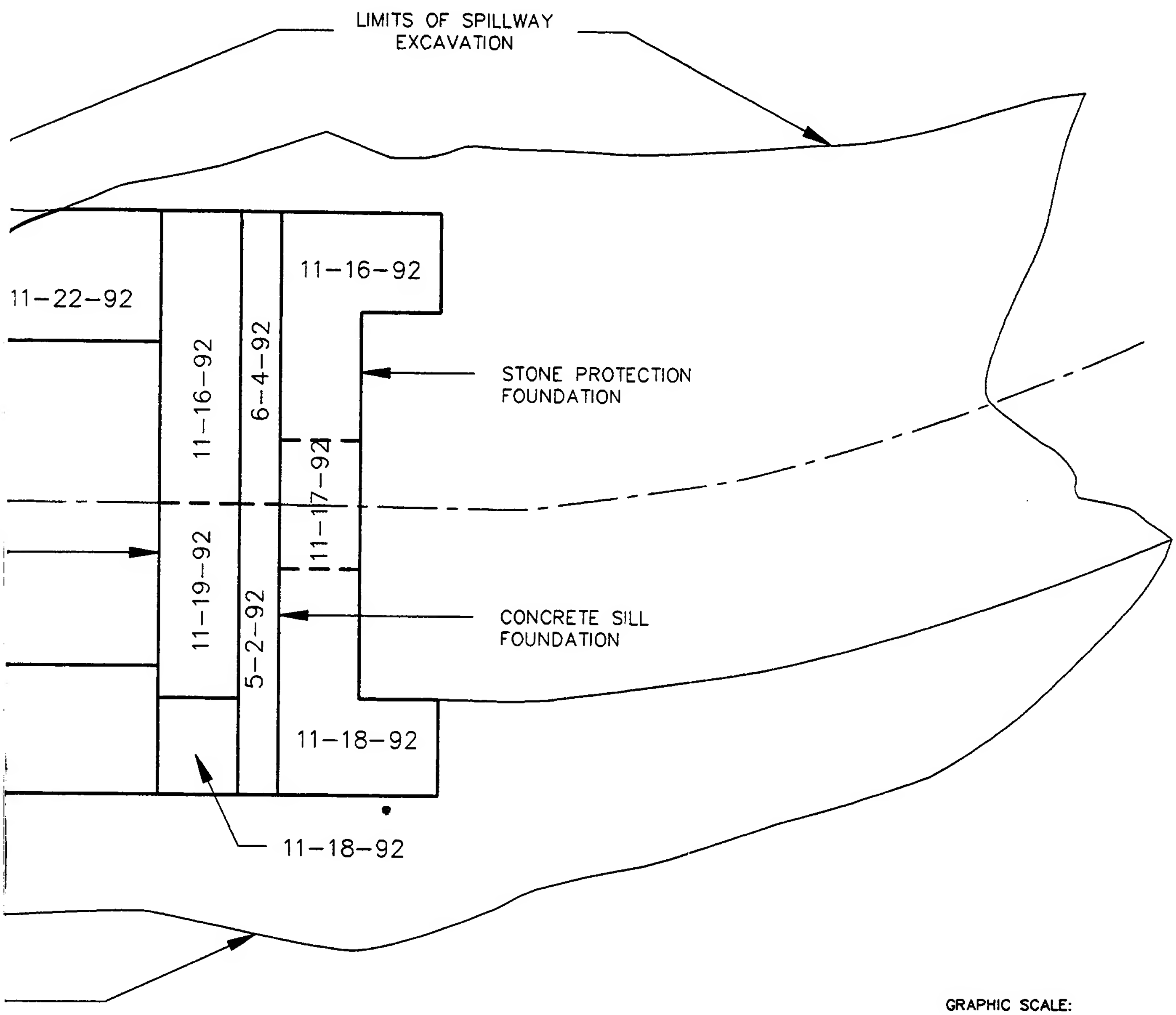
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	TR. BY	CH. BY	FILE No.
ERE		BAB	PLATE 23



RANDOM I FILL
PREVIOUSLY APPROVED
11-22-92
N
STONE PROTECTION
FOUNDATION
11-21-92
LIMITS OF SPILLWAY
EXCAVATION



GRAPHIC SCALE:

0 50 100 150

(SCALE IN FEET)

NOTE:

SEE LEGEND ON PLATE 22

LEGEND:

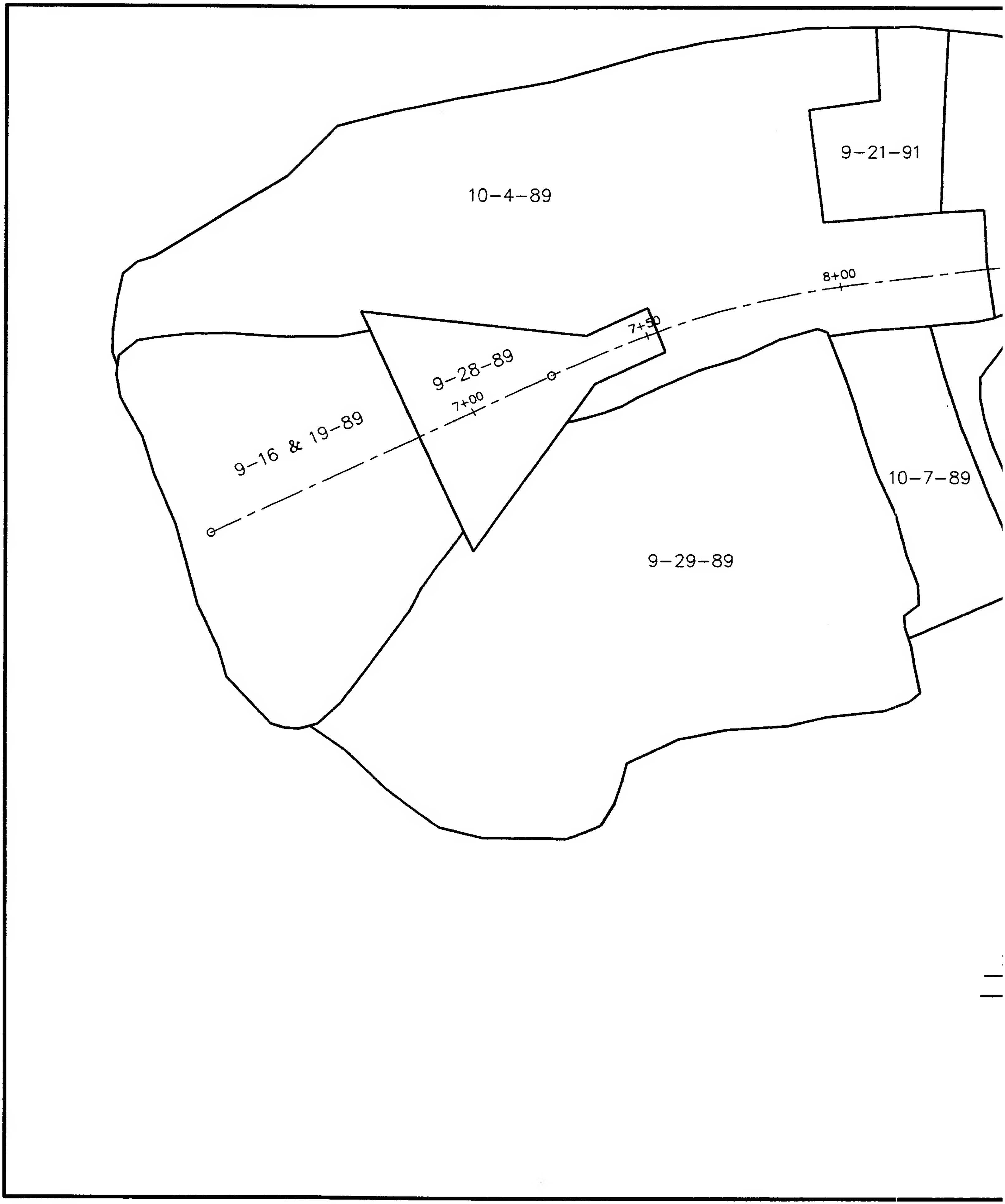
—— BOUNDARY OF APPROVAL AREA

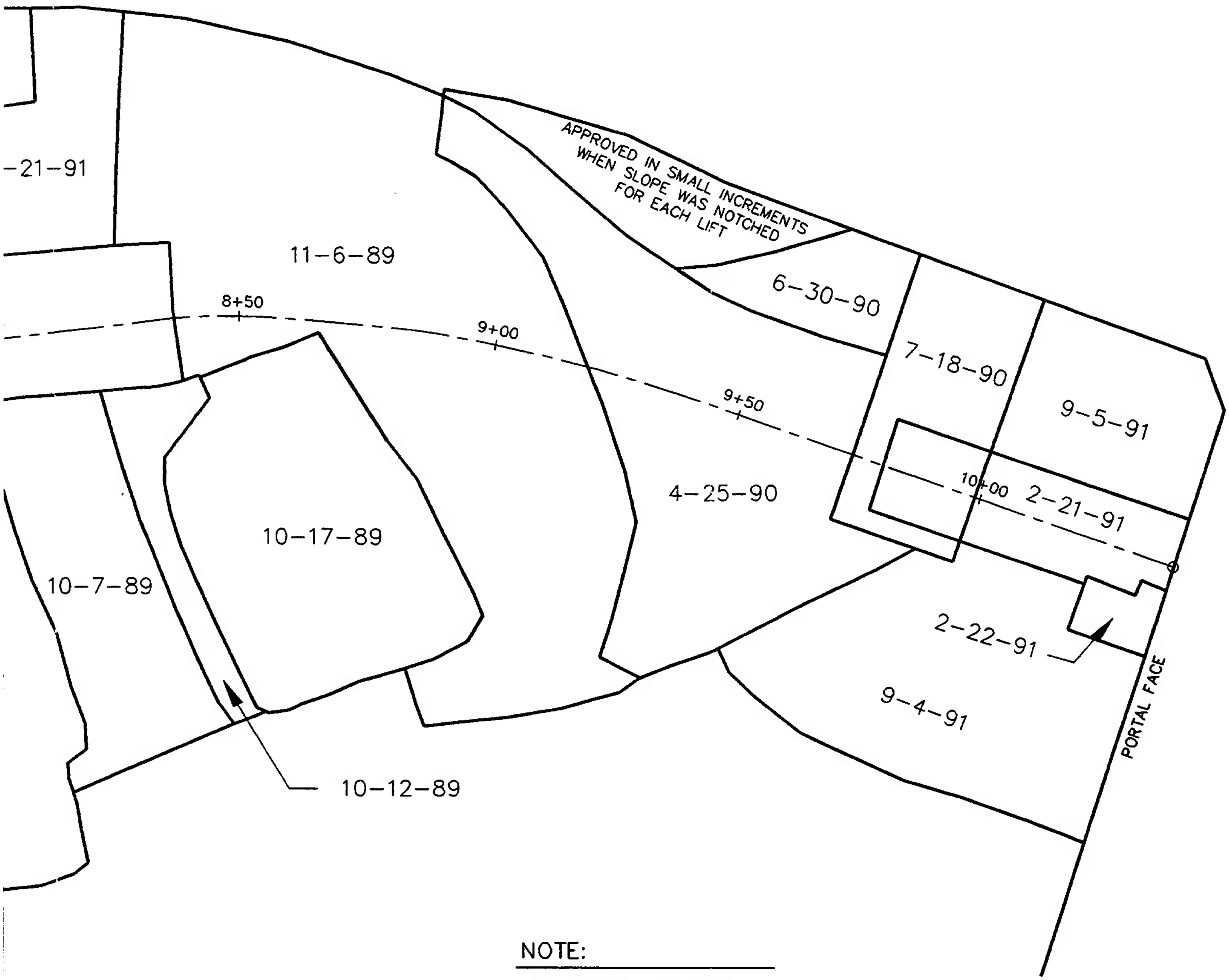
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FOUNDATION APPROVAL MAP
SPILLWAY

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

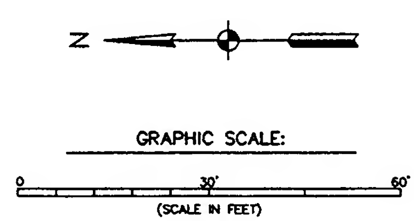
SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: for John Carrigan PAUL M. PARSONEAULT, RESIDENT ENGINEER
ERE		CEC	PLATE 24


9-21-91
10-4-89
8+00
7+50
9-28-89
7+00
9-16 & 19-89
10-7-89
9-29-89



NOTE:

SEE LEGEND ON PLATE 22



LEGEND:

BOUNDARY OF APPROVAL AREA

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

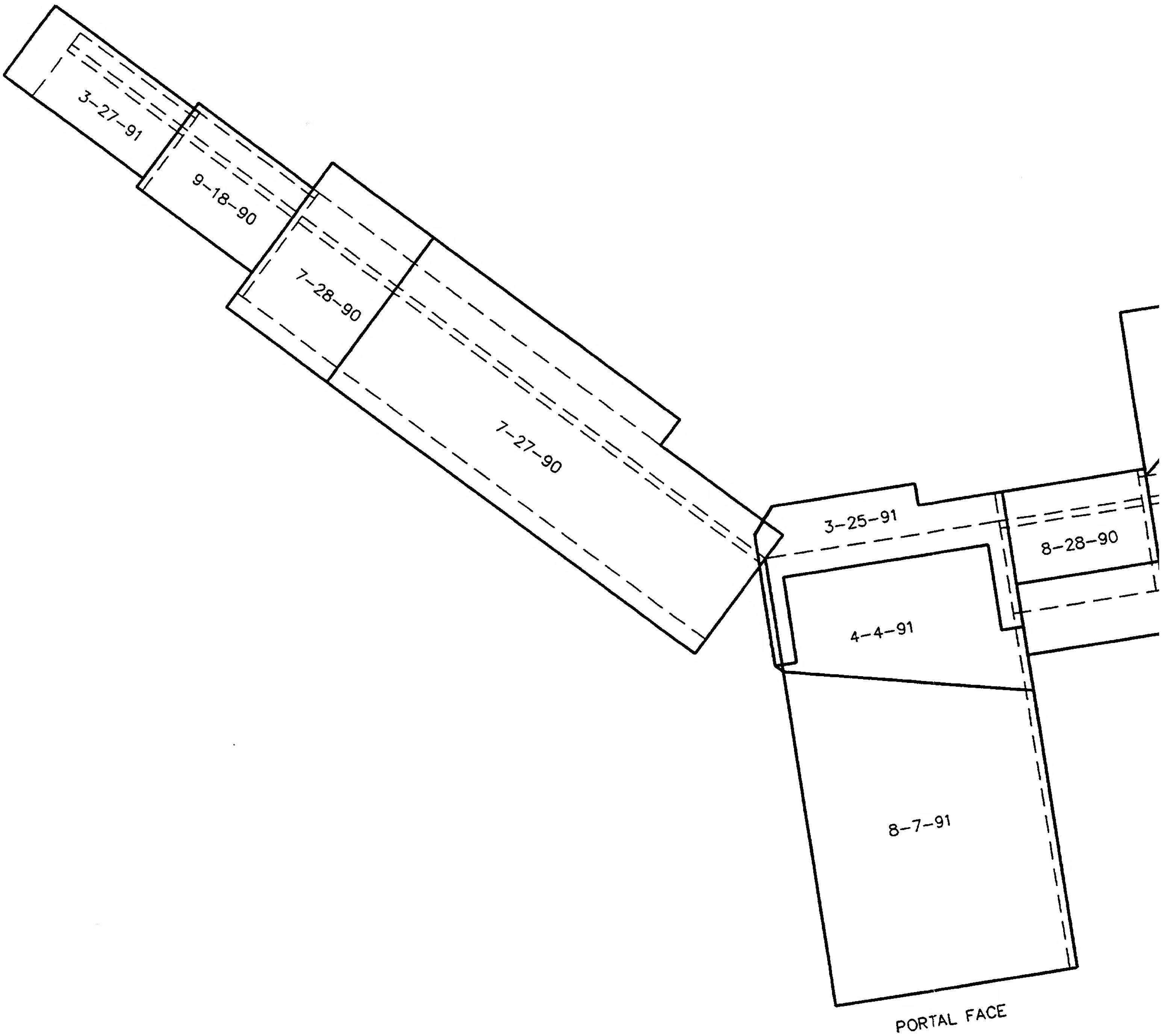
OUTLET WORKS
FOUNDATION APPROVAL MAP
INTAKE STRUCTURE AREA

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

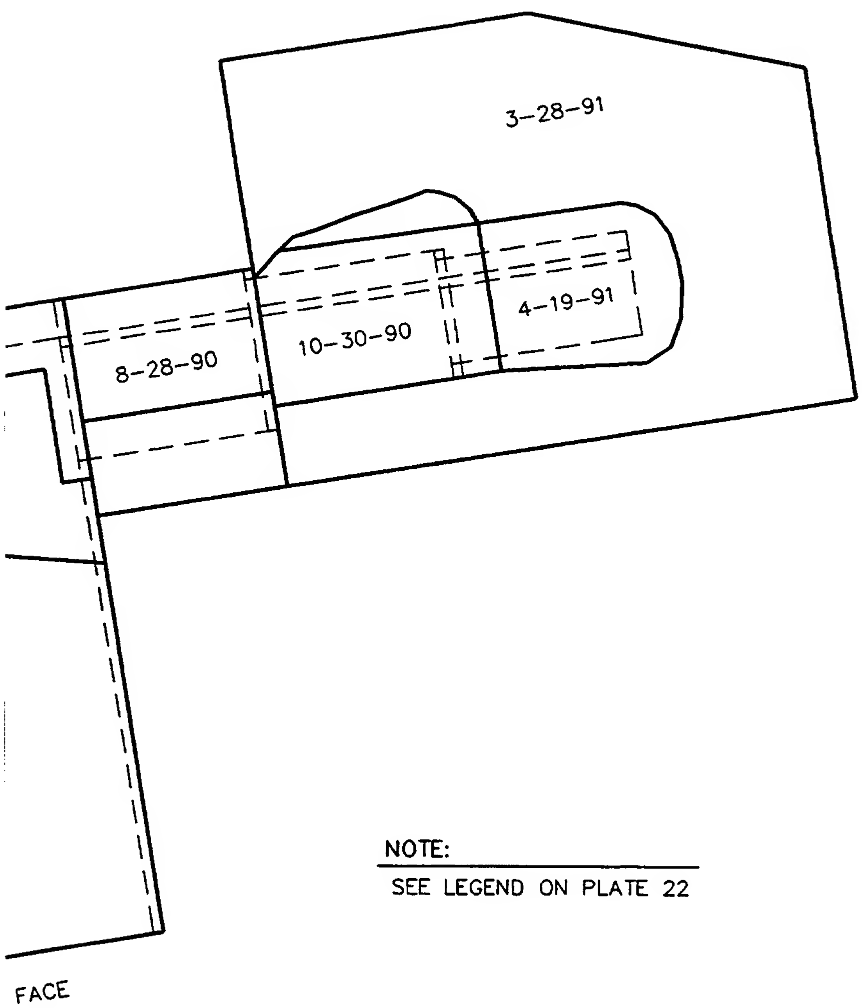
SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST

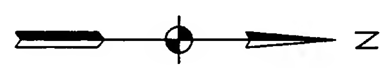
APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE NO.:
ERE		CEC	PLATE 25



C:\PROJECTS\LILDELL\W-FDNRPT\PL-26 04/04/95 12:44





NOTE:

SEE LEGEND ON PLATE 22

GRAPHIC SCALE:

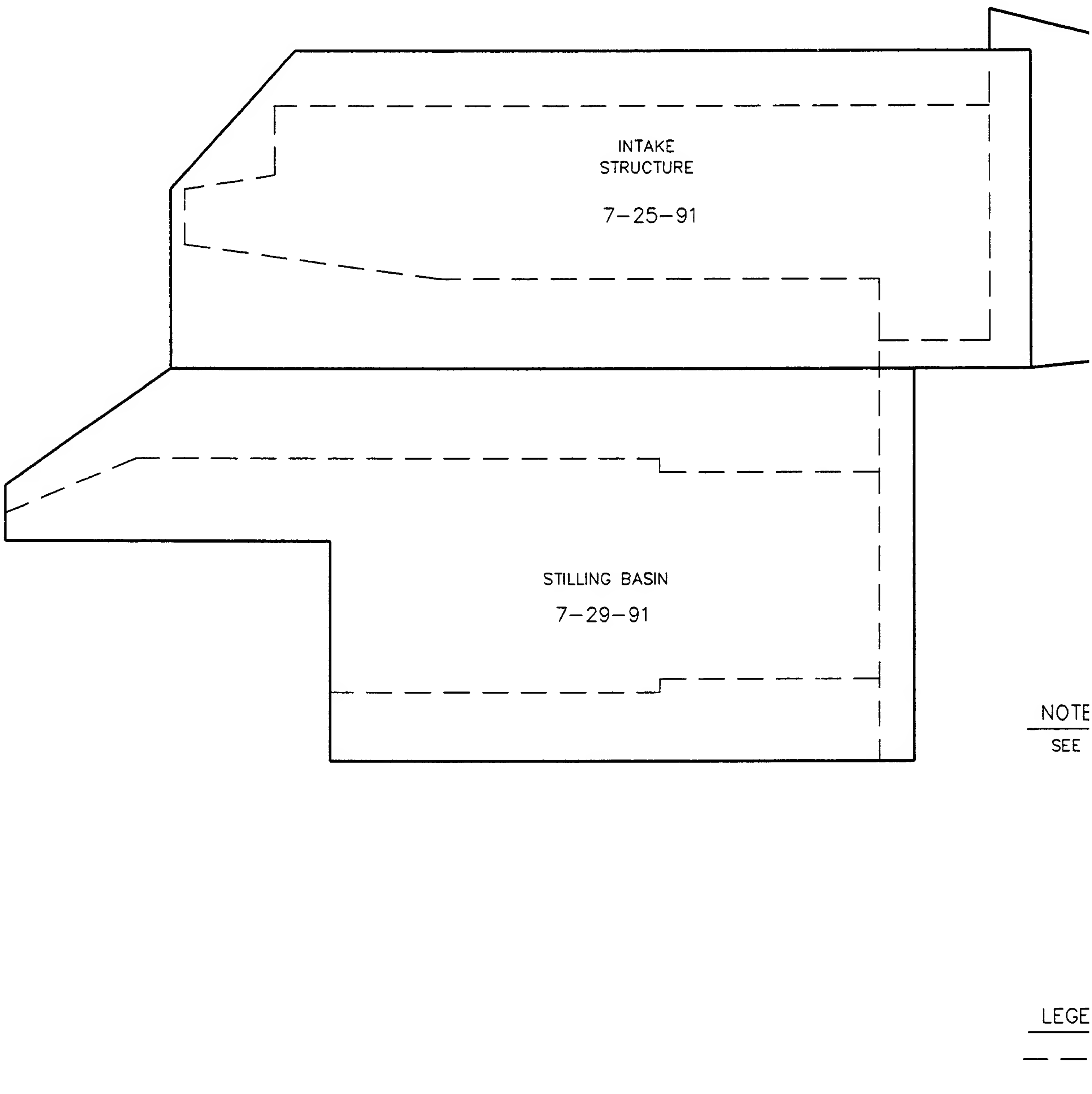
0 10' 20' 30' 40' 50'

(SCALE IN FEET)

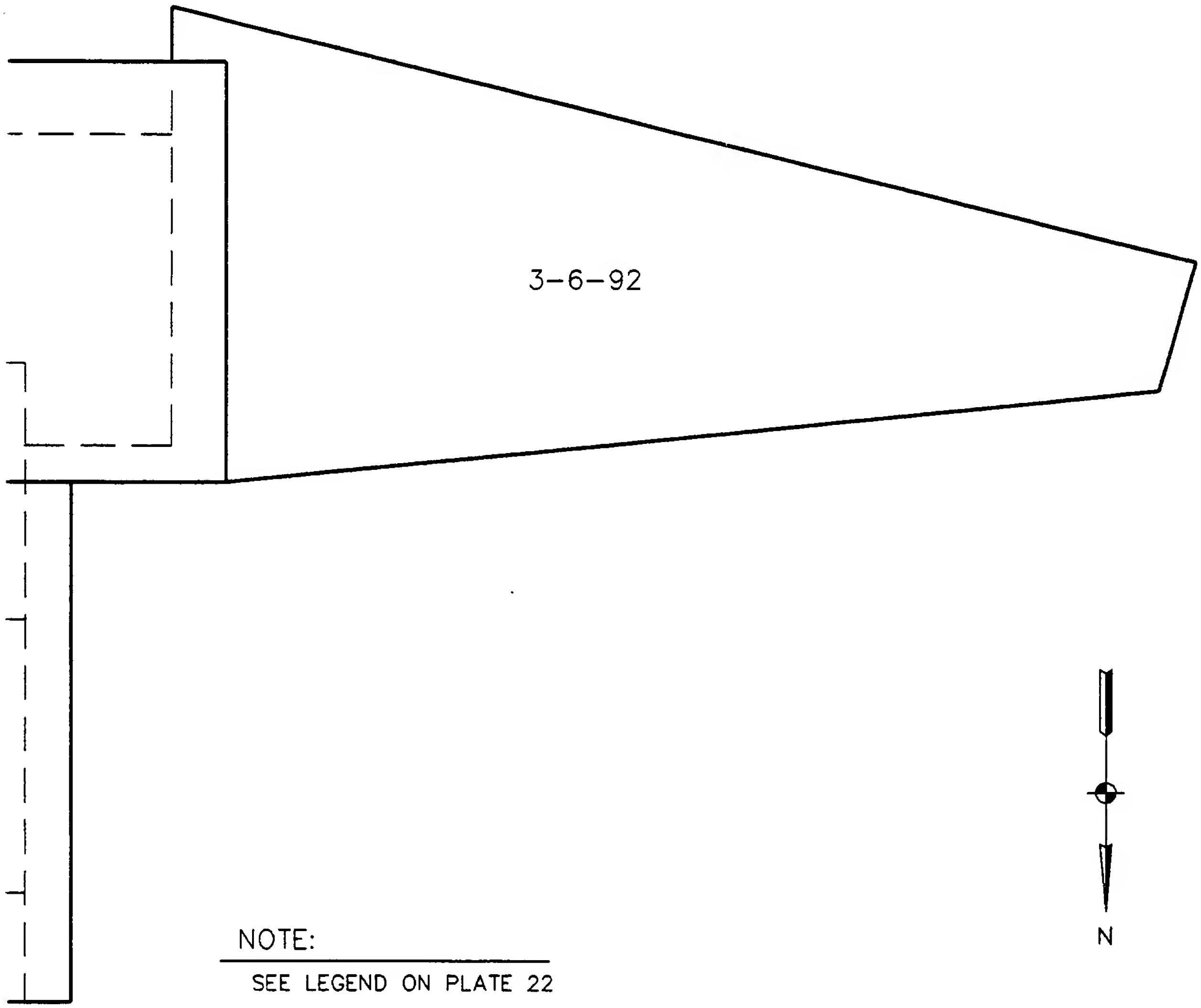
LEGEND:

- – – – OUTLINE OF STRUCTURE
- ——— BOUNDRY OF APPROVAL AREA

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH OUTLET WORKS FOUNDATION APPROVAL DOCS AREA			
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA			
SUBMITTED: Robert L. Frent for CARL E. COLE RESIDENT GEOLOGIST		APPROVED: for [signature] PAUL M. PARSONEAULT RESIDENT ENGINEER	
ERE		CEC	PLATE 26



C:\PROJECTS\ULDELL\W-FDNRPT\PL-27 03/10/95 08:15



NOTE:

SEE LEGEND ON PLATE 22

GRAPHIC SCALE:

(SCALE IN FEET)

LEGEND:

— — — OUTLINE OF STRUCTURE

——— BOUNDARY OF APPROVAL AREA

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

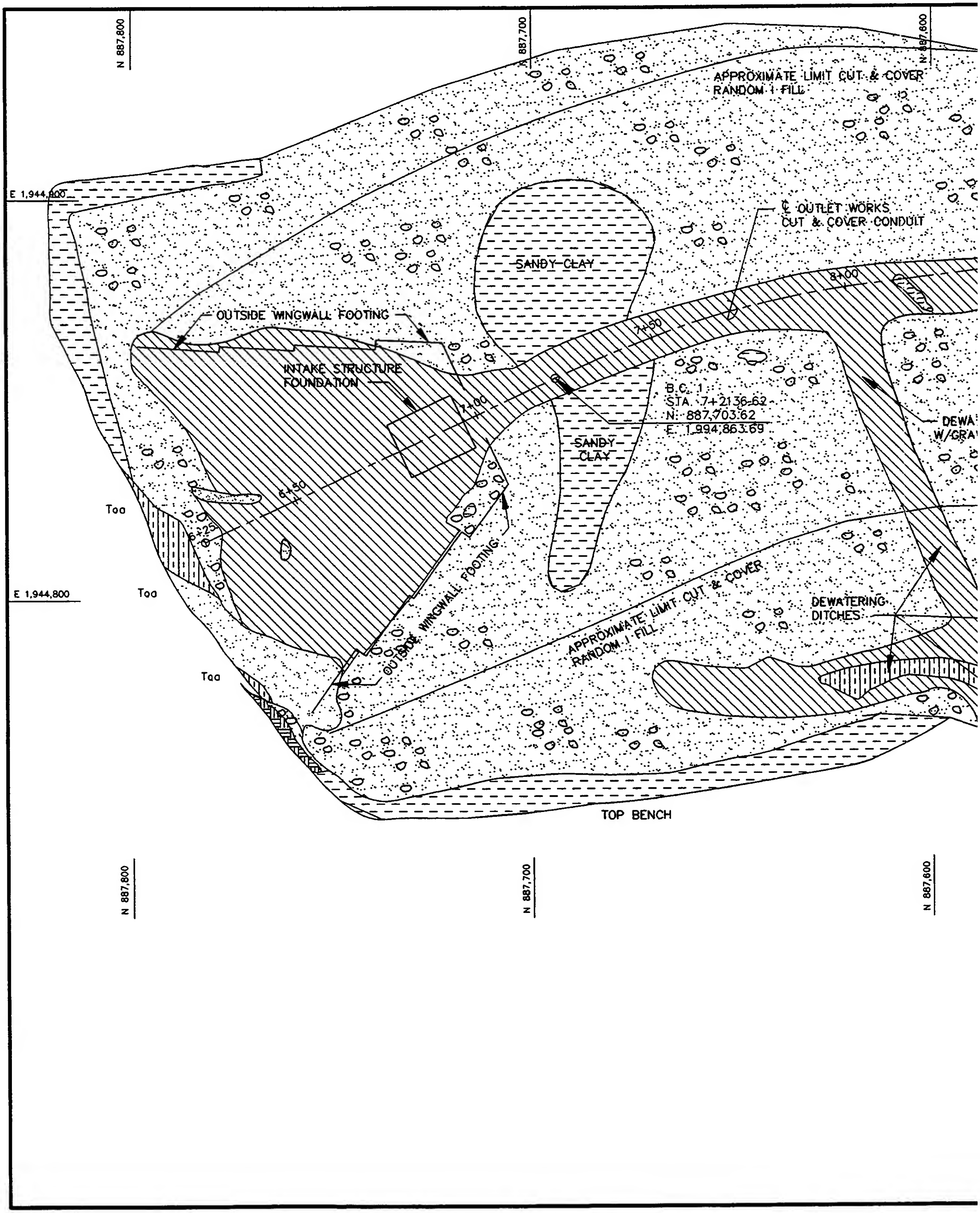
OUTLET WORKS

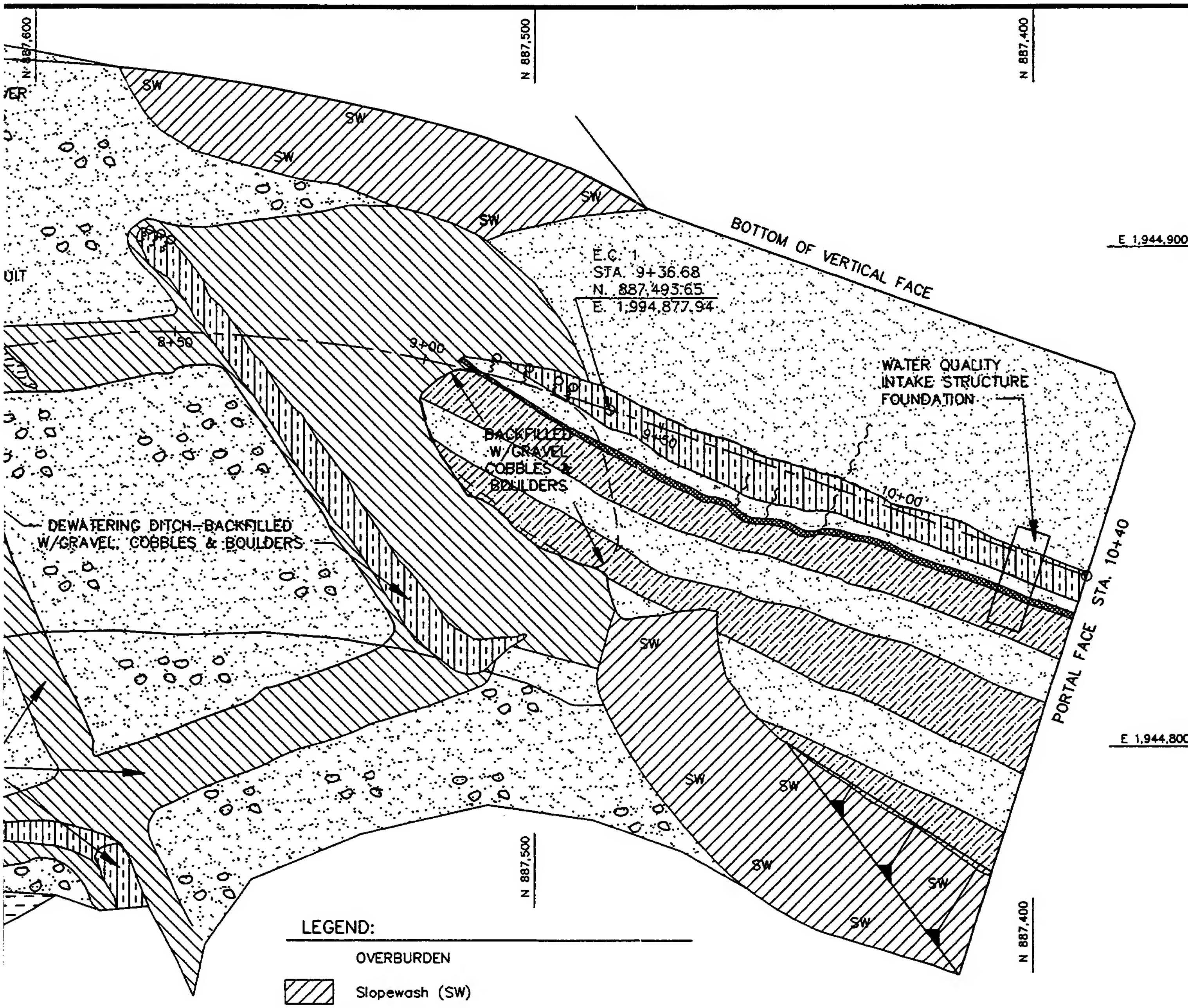
FOUNDATION APPROVAL MAP
PARLEY'S CREEK DIVERSION STRUCTURE

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
Robert L. for CARL E. COLE RESIDENT GEOLOGIST	PAUL M. PARSONEAULT RESIDENT ENGINEER

			FILE No:
ERE		CEC	PLATE 27


N 887,800
N 887,700
N 887,600
E 1,944,900
E 1,944,800
APPROXIMATE LIMIT CUT & COVER
RANDOM I FILL
℄ OUTLET WORKS
CUT & COVER CONDUIT
SANDY CLAY
OUTSIDE WINGWALL FOOTING
INTAKE STRUCTURE
FOUNDATION
8+00
7+50
7+00
6+50
6+25
B.C. 1
STA. 7+2136.62
N. 887,703.62
E. 1,994,863.69
SANDY
CLAY
Tοa
Tοa
Tοa
OUTSIDE WINGWALL FOOTING
OUTSIDE WINGWALL FOOTING
APPROXIMATE LIMIT CUT & COVER
RANDOM I FILL
DEWATERING
DITCHES
TOP BENCH
N 887,800
N 887,700
N 887,600



LEGEND:

OVERBURDEN

- Slopewash (SW)
- Organics
- Top soil
- Recent alluvium – Interbedded, organic beds, sandy clay, clayey sand and sand layers
- Sand and gravel
- Basal gravel, cobble and boulder layer
- Toa Older Alluvium

FRONTIER FORMATION

- Undifferentiated and silty sandstone,– sandy siltstone, residual soil
- Sandstone – gray, hard
- Claystone
- Siltstone
- Shear
- Spring

N

GRAPHIC SCALE:

0 30' 60'

(SCALE IN FEET)

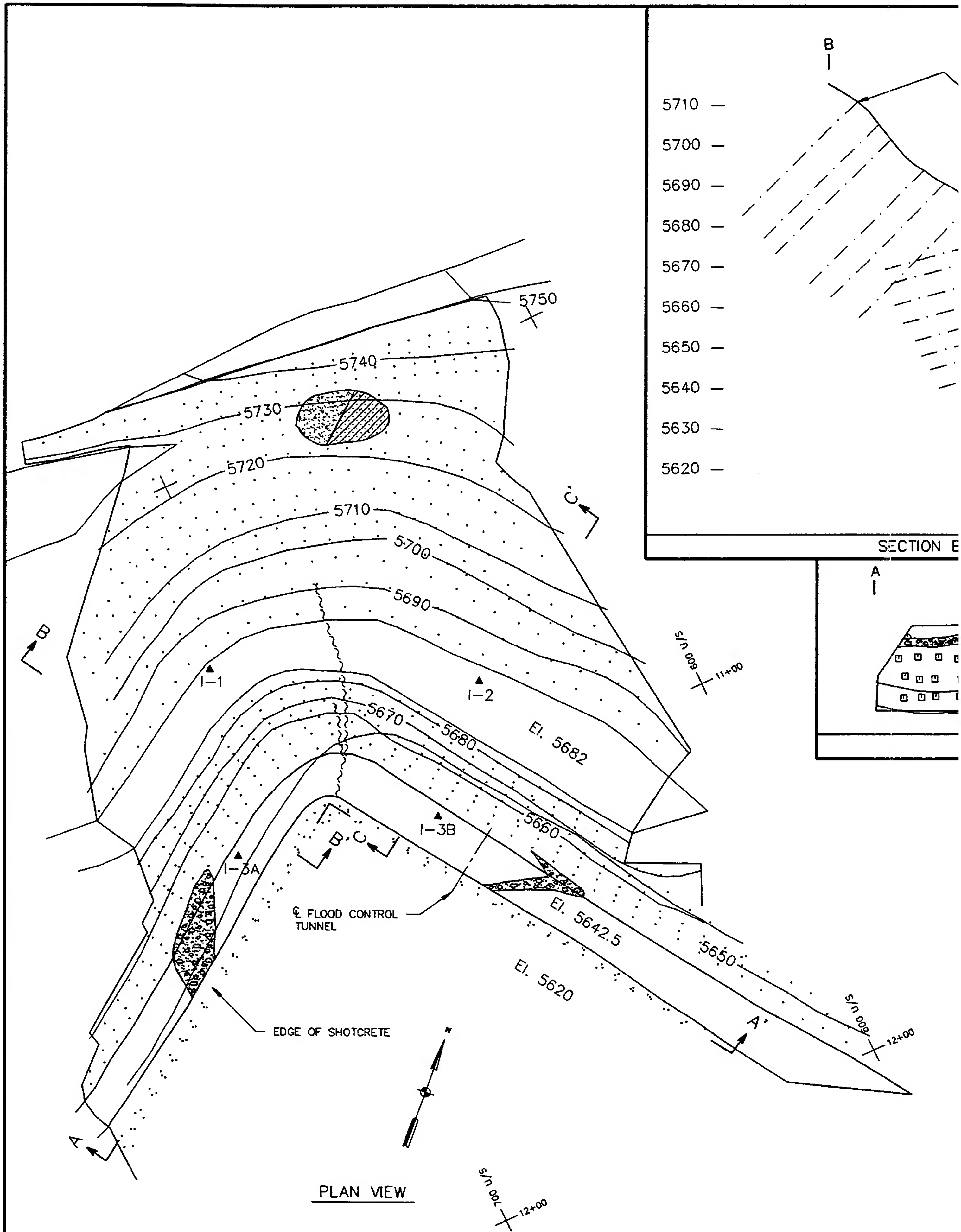
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

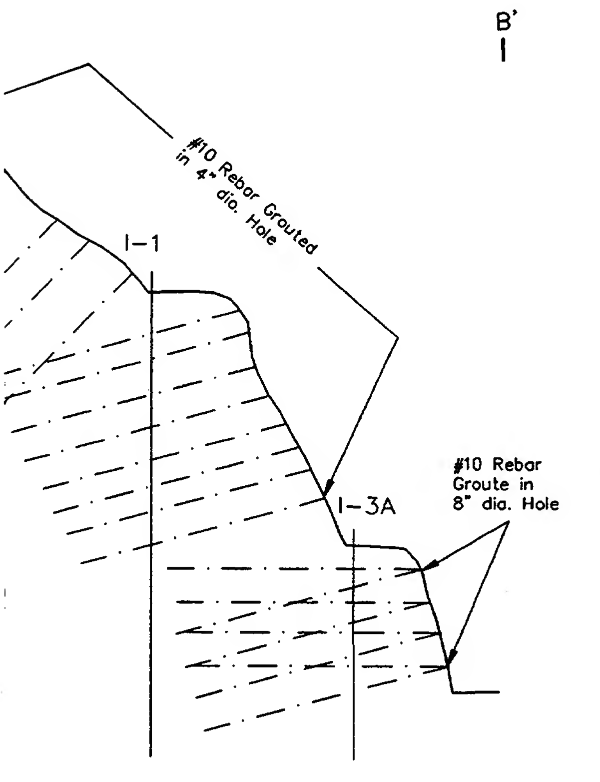
OUTLET WORKS

GEOLOGIC MAP OF
INTAKE STRUCTURE AND CUT AND COVER CONDUIT

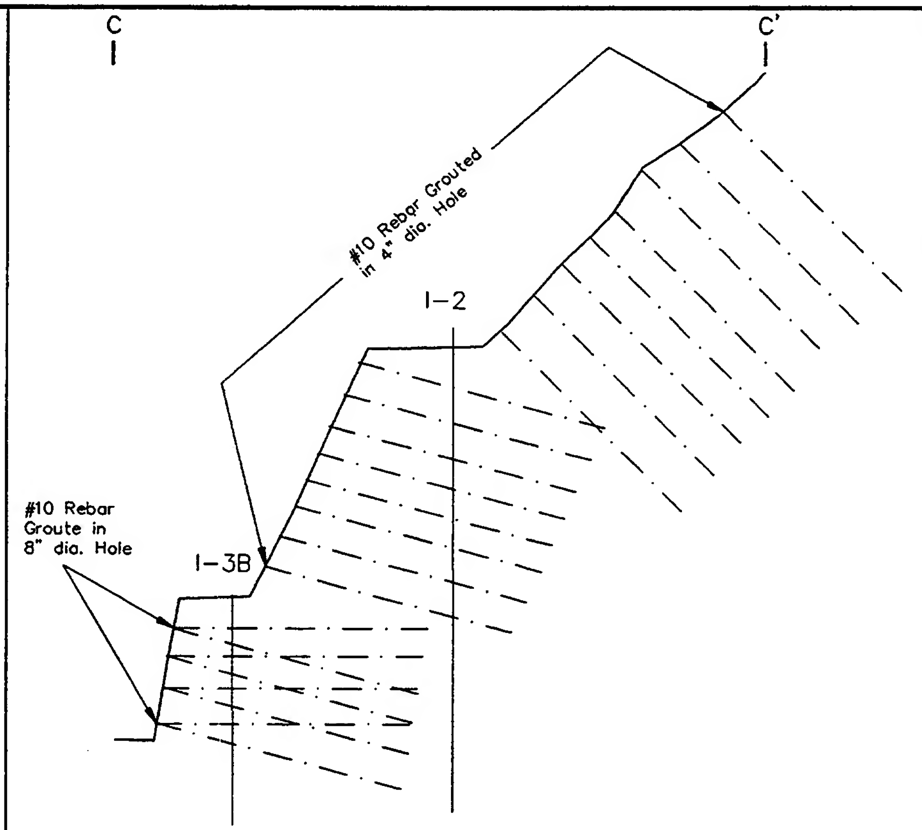
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Jewett for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
ERE		CEC	PLATE 28

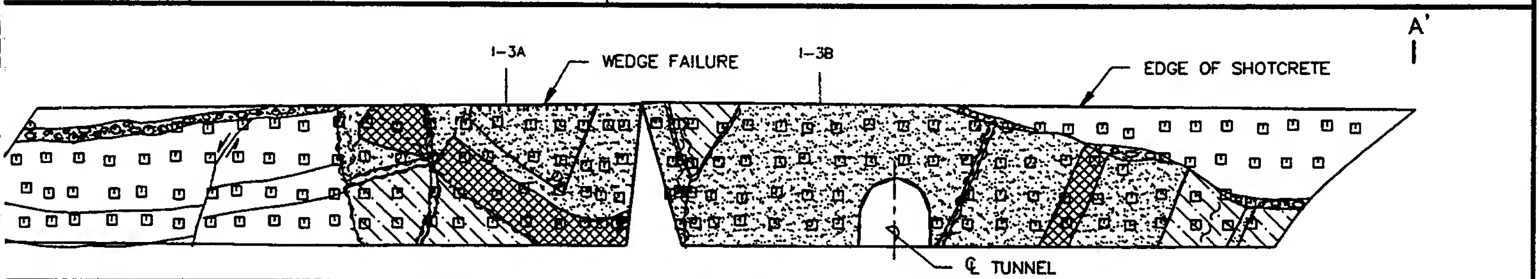

5750
5740
5730
5720
5710
5700
5690
5670
5680
5660
5650
El. 5682
El. 5642.5
El. 5620
I-1
I-2
I-3A
I-3B
℄ FLOOD CONTROL TUNNEL
EDGE OF SHOTCRETE
600 u/s
11+00
12+00
700 u/s
A
A'
B
C
PLAN VIEW
5710
5700
5690
5680
5670
5660
5650
5640
5630
5620
SECTION B



SECTION B – B'



SECTION C – C'



SECTION A – A' – ALONG VERTICAL SLOPE

GRAPHIC SCALE:

10' 0 10' 20' 30' 40' 50' 60'

(SCALE IN FEET)

LEGEND

- Slopewash
- Bedrock
- Older Alluvium
- Conglomerate
- Sandstone
- Siltstone
- Claystone/Soapstone
- Shear
- Fault
- 5650 Contour line
- #10 Rebar Grouted in 8" dia. Hole
- #10 Rebar Grouted in 4" dia. Hole
- I–2 ▲ Inclinometer
- Rock Fall

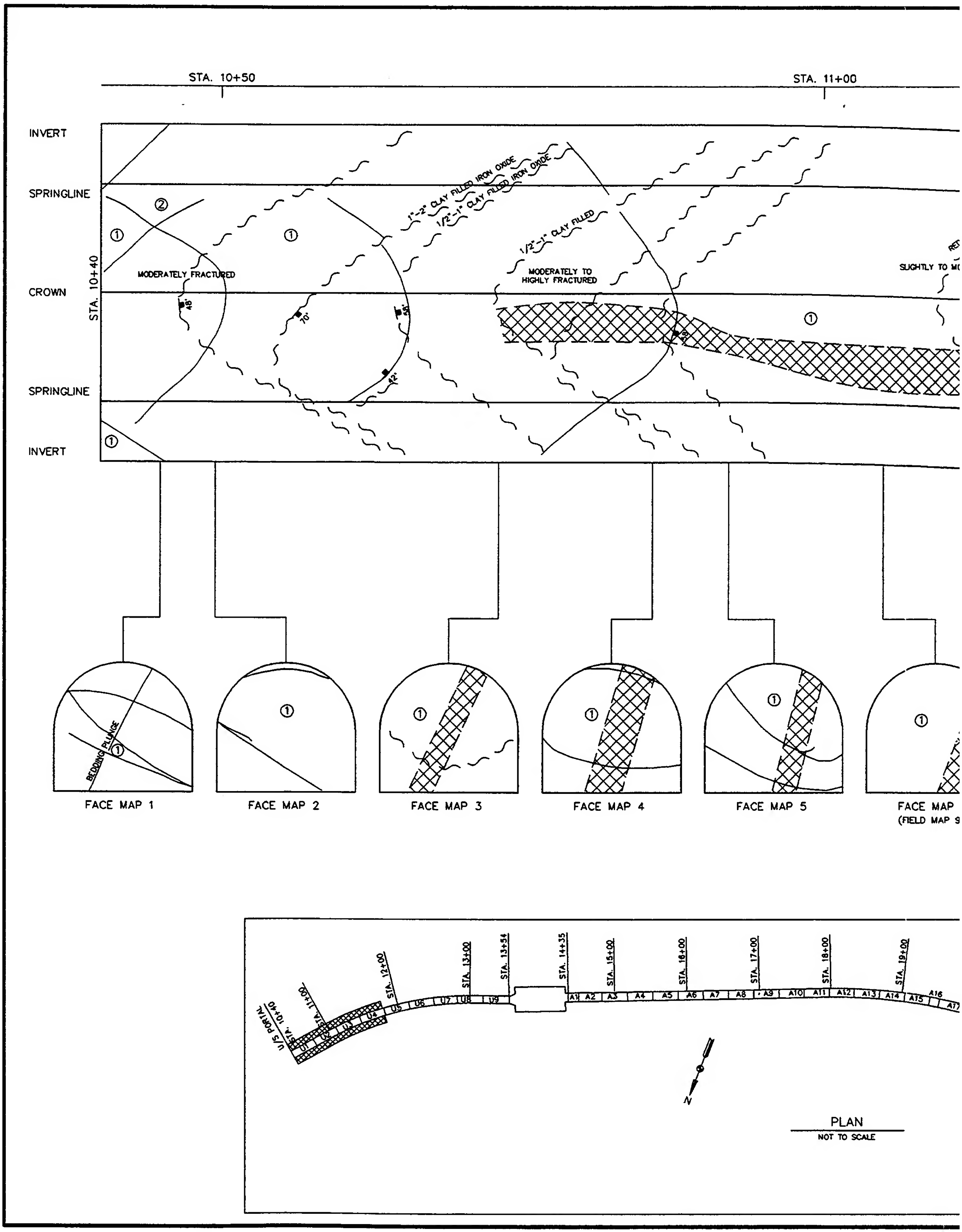
2+00

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

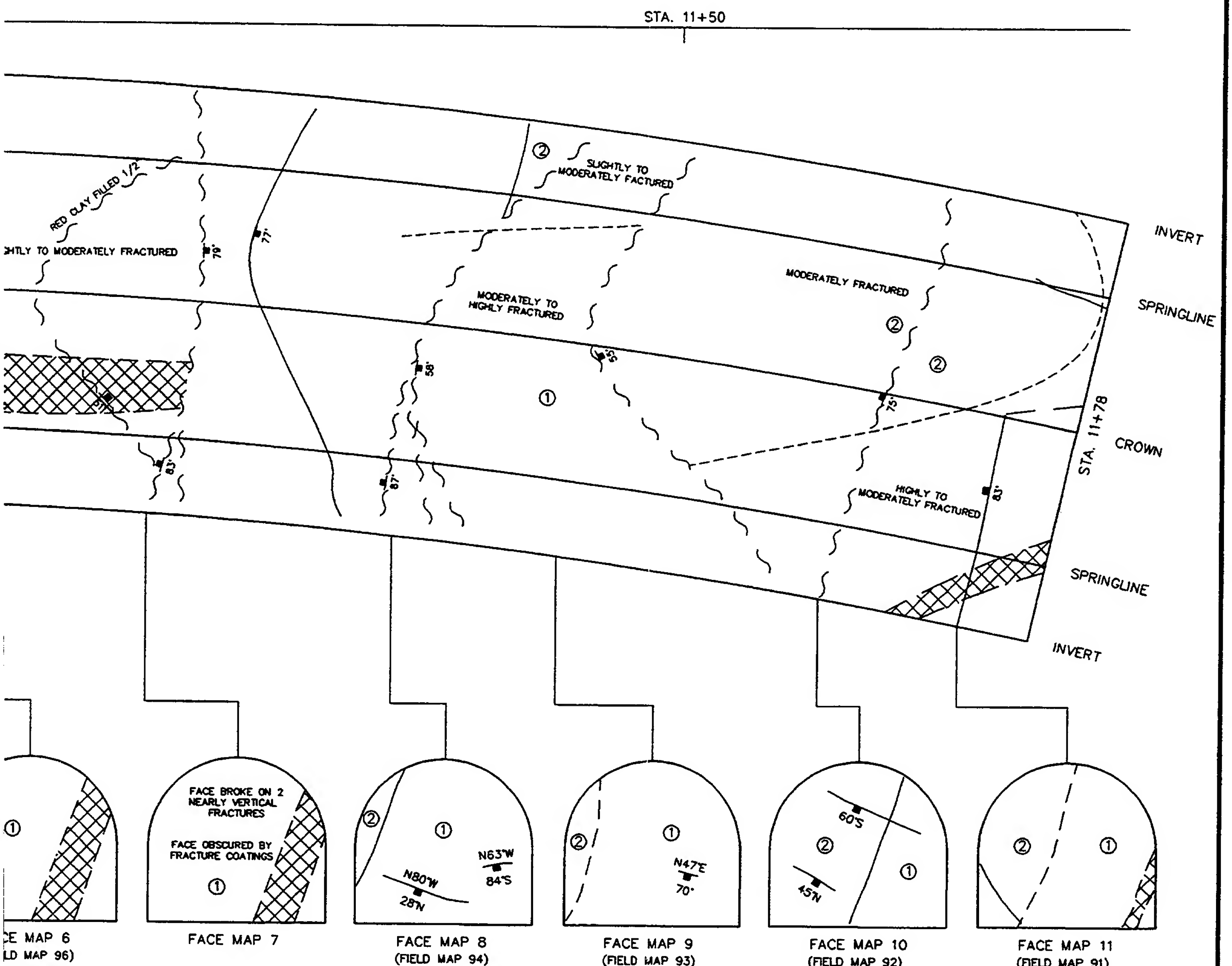
OUTLET WORKS
GEOLOGIC MAP AND SECTIONS
UPSTREAM PORTAL

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for JOHN W. ROADIFER			APPROVED: for PAUL M. PARSONEAULT RESIDENT ENGINEER
DR. BY: JWR	CHECKED BY: JWR	CHECKED BY: MDR	FILE No.: PLATE 29



STA. 10+50
STA. 11+00
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 10+40
MODERATELY FRACTURED
1"-2" CLAY FILLED IRON OXIDE
1/2"-1" CLAY FILLED IRON OXIDE
1/2"-1" CLAY FILLED
MODERATELY TO HIGHLY FRACTURED
SLIGHTLY TO M
48°
70°
50°
42°
58°
BEDDING PLUNGE
FACE MAP 1
FACE MAP 2
FACE MAP 3
FACE MAP 4
FACE MAP 5
FACE MAP
(FIELD MAP
U/S PORTAL STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
STA. 19+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
A17
N
PLAN
NOT TO SCALE

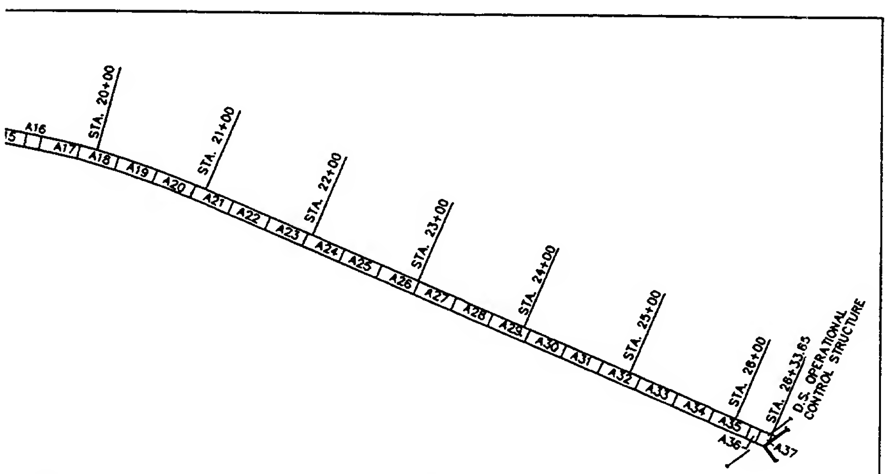


LEGEND:

VERY HARD BLOCKY MATERIAL

NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS



GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)

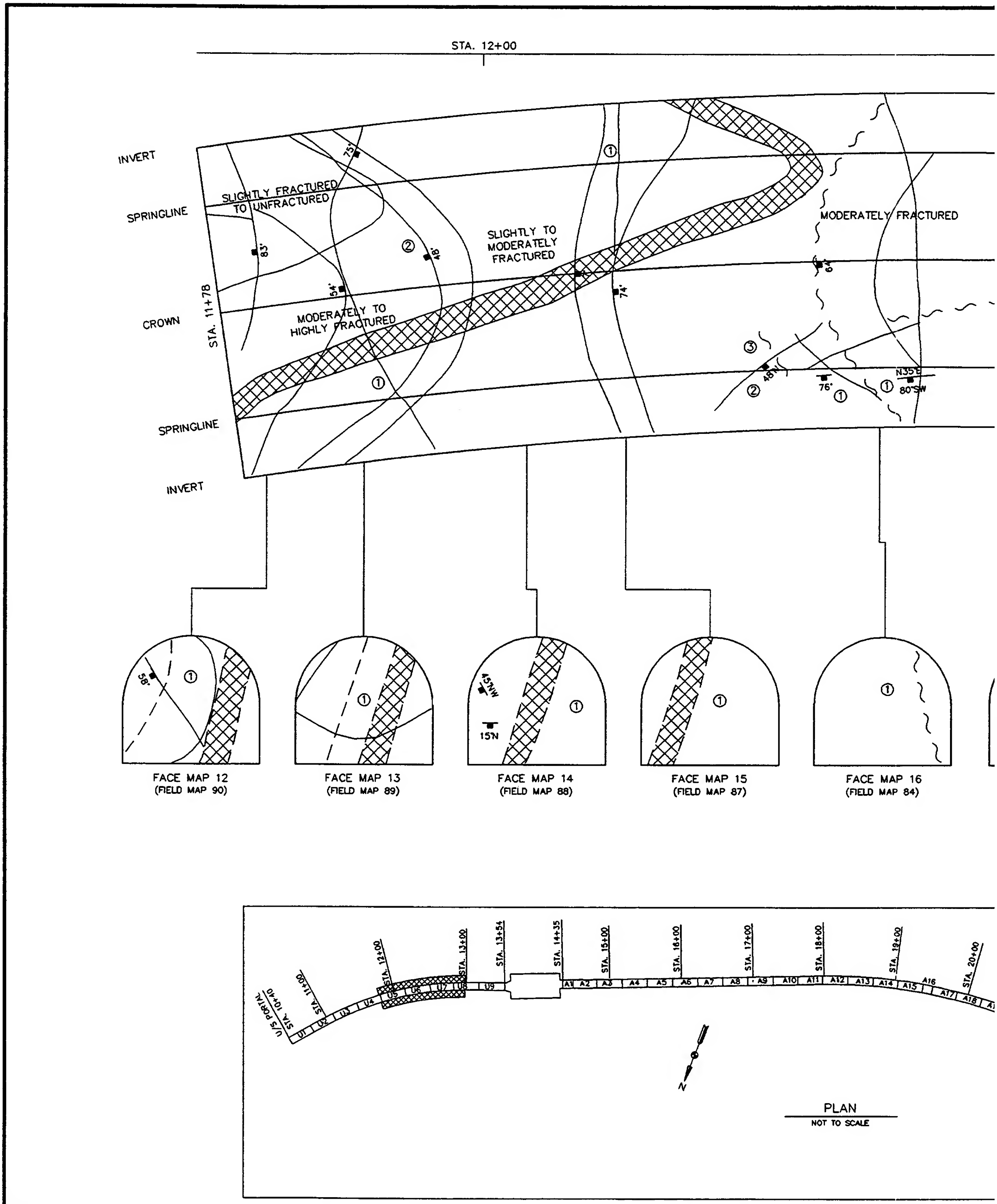
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 10+40 TO STA. 11+78

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
Robert L. Trent for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE		CEC	PLATE 30



FACE MAP 12
(FIELD MAP 90)

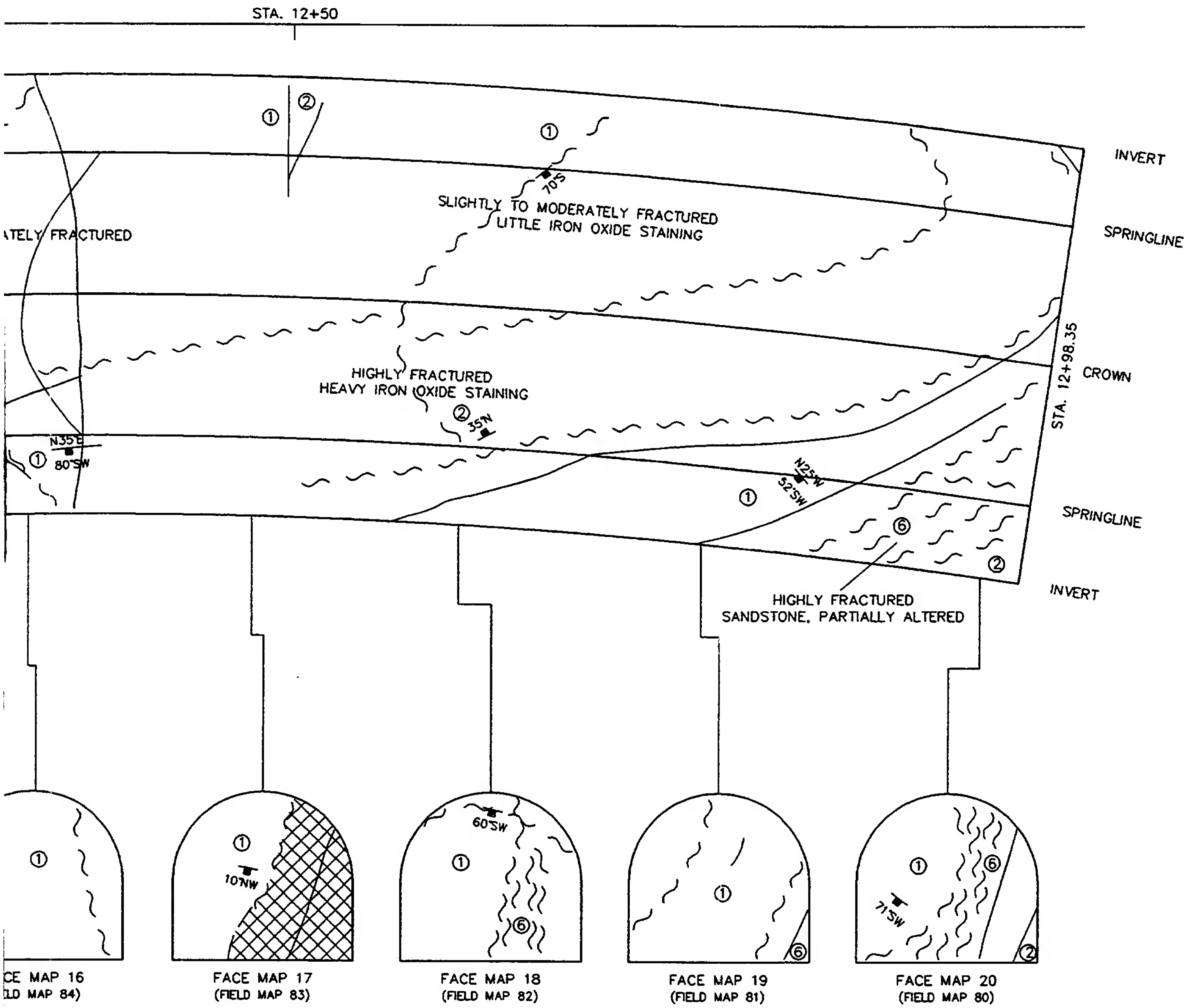
FACE MAP 13
(FIELD MAP 89)

FACE MAP 14
(FIELD MAP 88)

FACE MAP 15
(FIELD MAP 87)

FACE MAP 16
(FIELD MAP 84)

PLAN
NOT TO SCALE



LEGEND:

VERY HARD BLOCKY MATERIAL

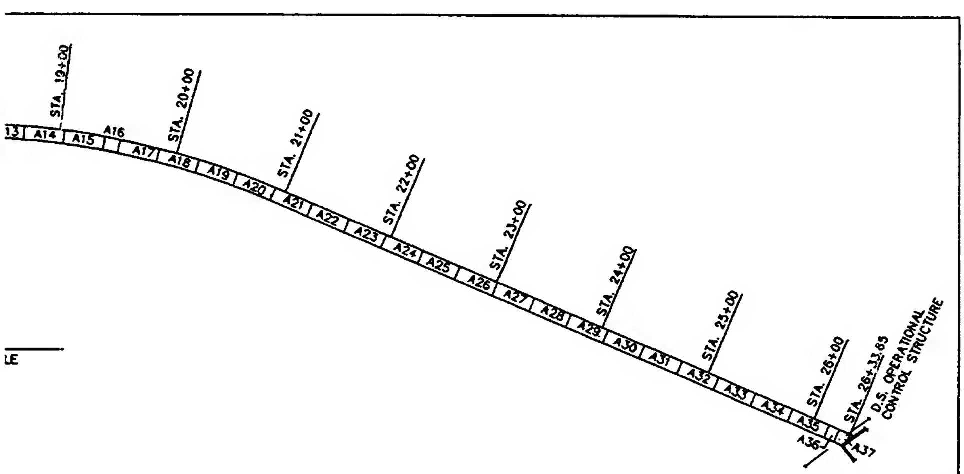
NOTE

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)



LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS

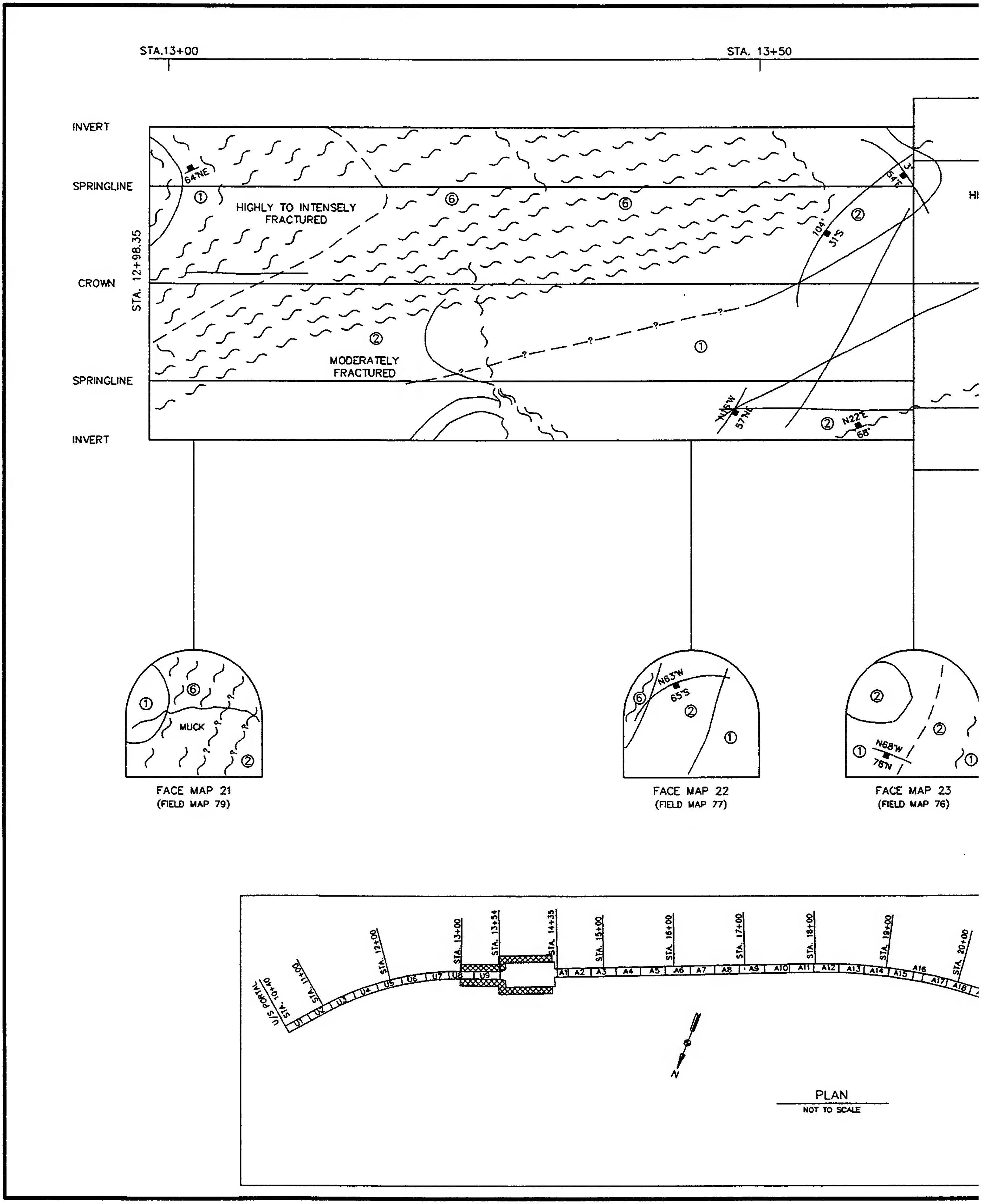
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 11+78 TO STA. 12+98.35

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

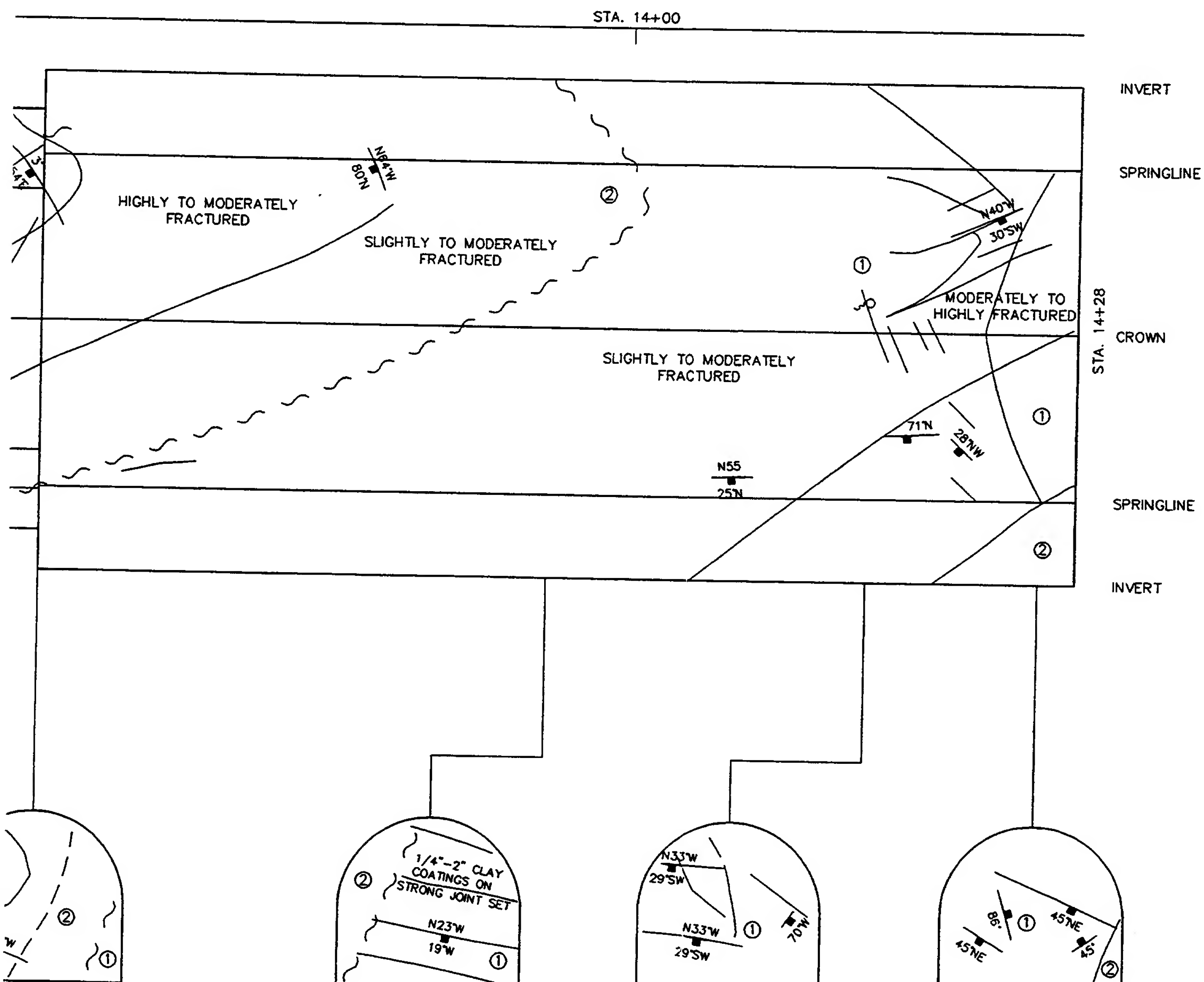
SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: for PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CK. BY:	GEOL. BY:	FILE NO.:
ERE		CEC	PLATE 31



STA.13+00
STA. 13+50
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 12+98.35
HIGHLY TO INTENSELY FRACTURED
MODERATELY FRACTURED
64°NE
104°
31°S
54°E
N15°W
57°NE
N22°E
68°
MUCK
N63°W
65°S
N68°W
78°N
FACE MAP 21
(FIELD MAP 79)
FACE MAP 22
(FIELD MAP 77)
FACE MAP 23
(FIELD MAP 76)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
STA. 19+00
STA. 20+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
A17
A18
N
PLAN
NOT TO SCALE



CE MAP 23
(LD MAP 76)

FACE MAP 24
(FIELD MAP 74)

FACE MAP 25
(FIELD MAP 73)

FACE MAP 26
(FIELD MAP 72)

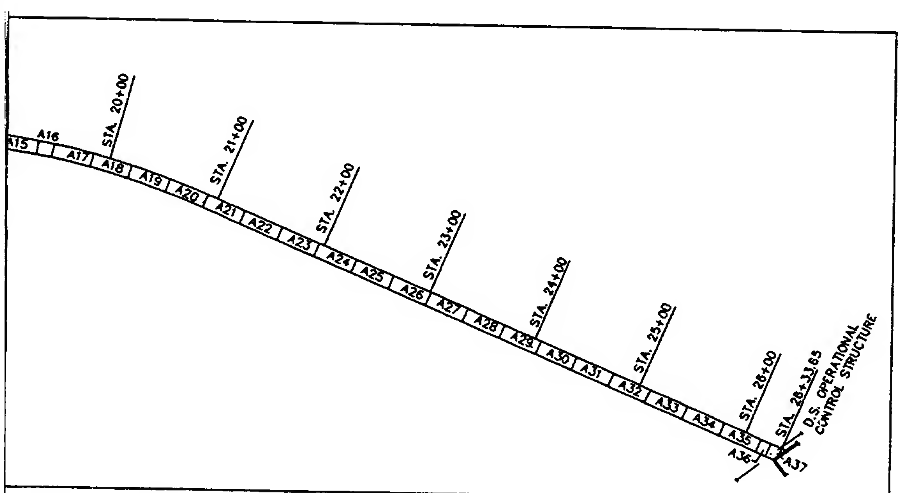
NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)



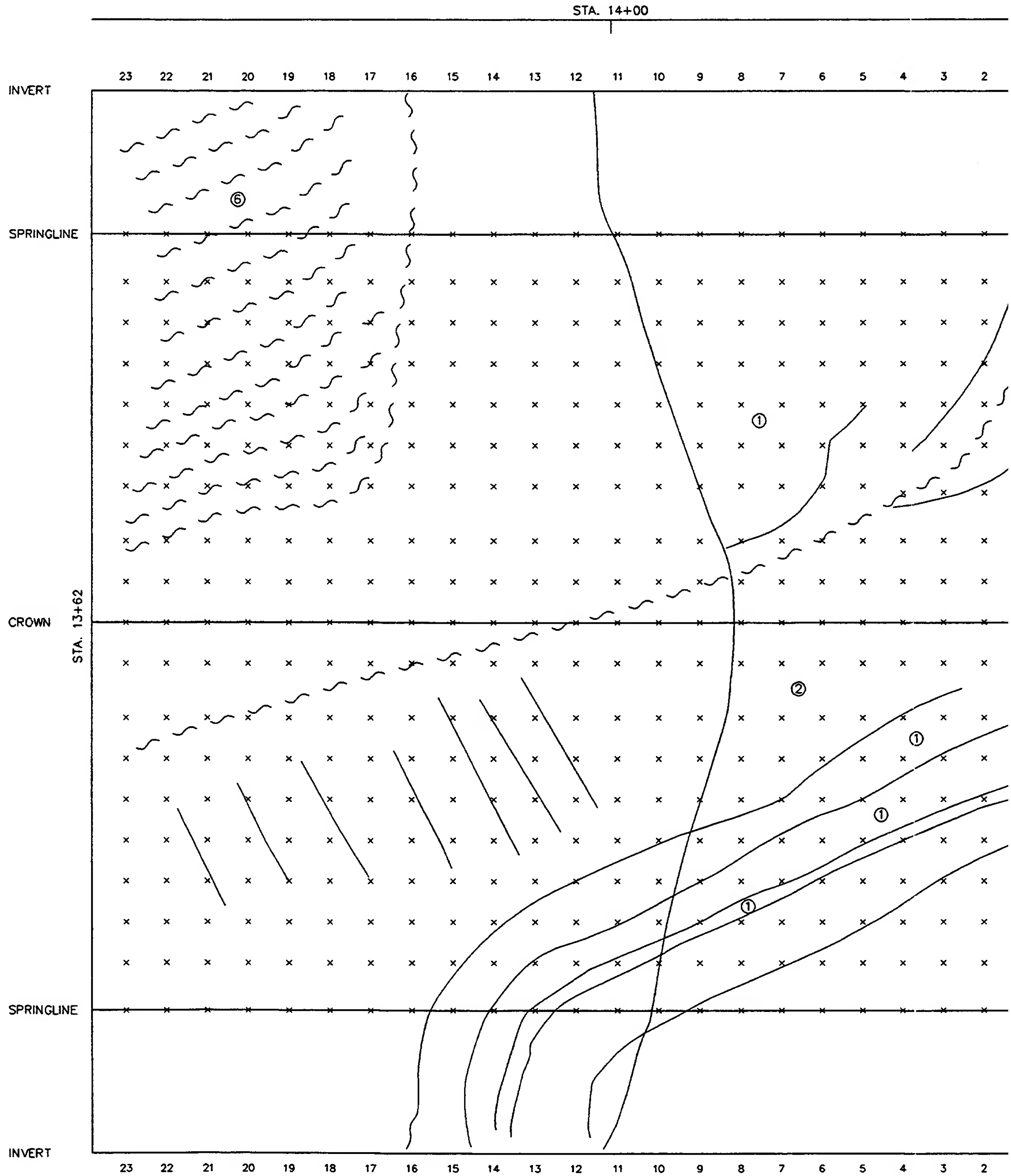
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 12+98.35 TO STA. 14+28

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

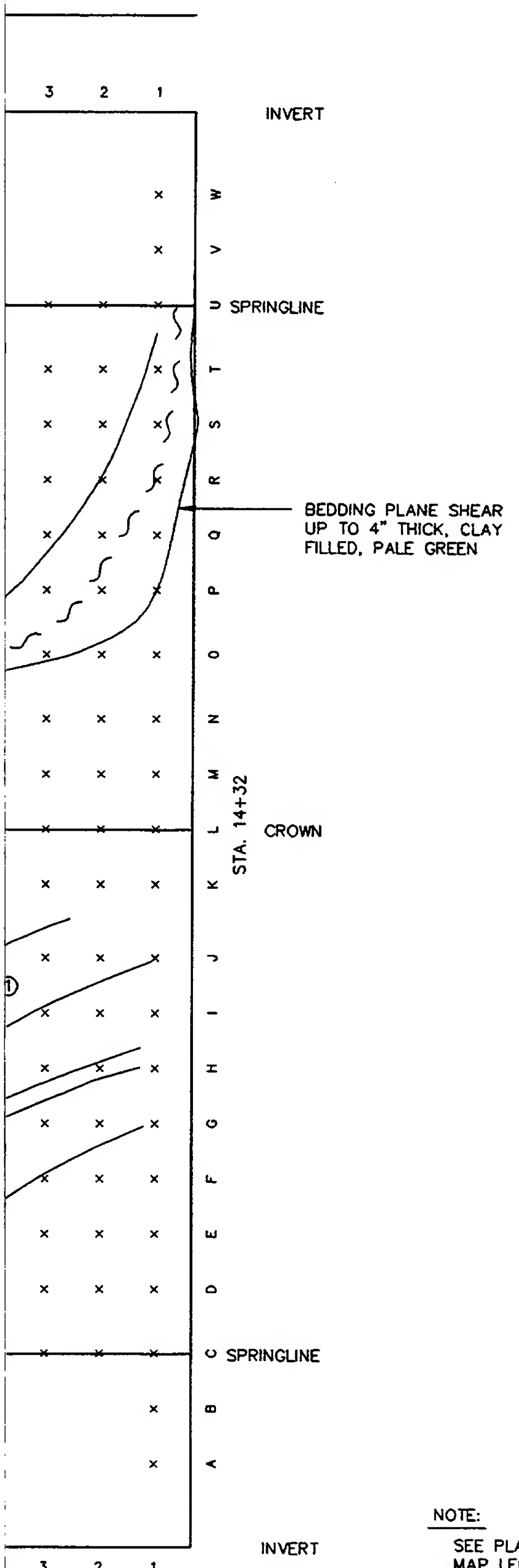
SUBMITTED:	APPROVED:
Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

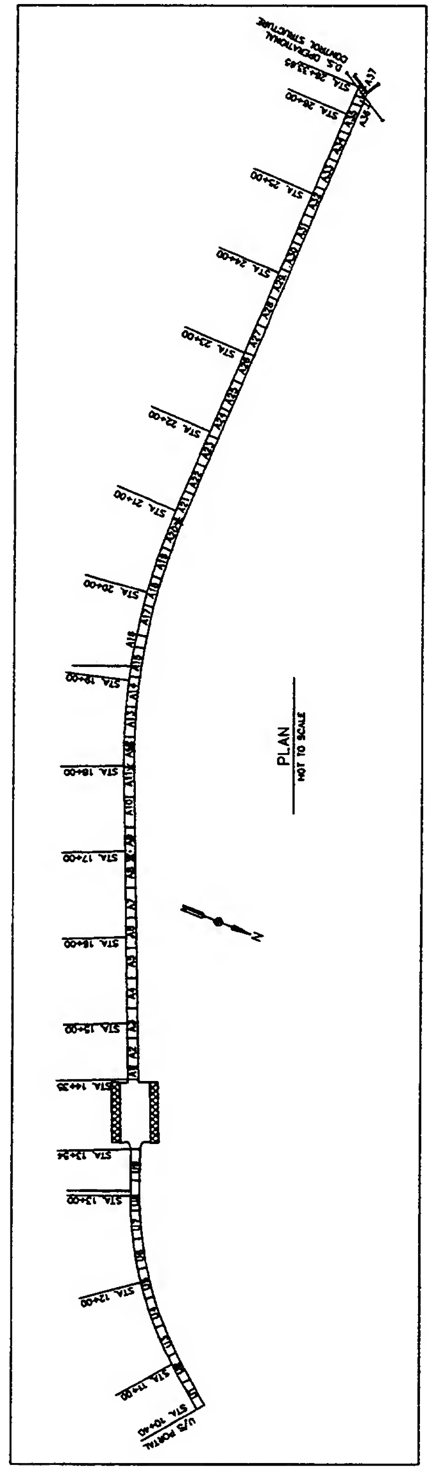
DR. BY:	CH. BY:	GEOL. BY:	FILE No.:
ERE		CEC	PLATE 32



NOTE

X = ROCK BOLTS, BOLTS BETWEEN K AND J ARE 4' ON CENTER.





NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

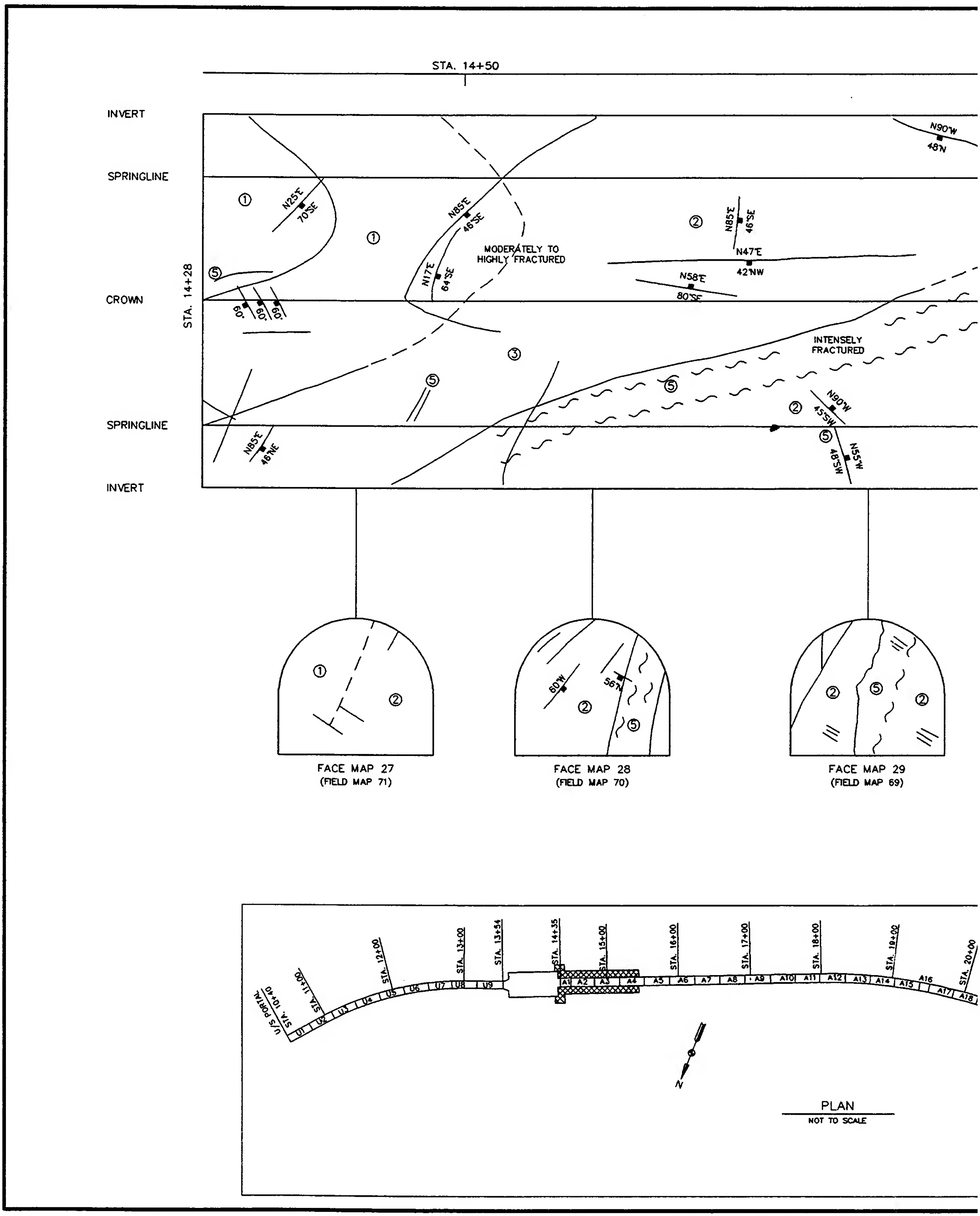
OUTLET WORKS

EMERGENCY CONTROL CHAMBER
GEOLOGIC MAP STA. 13+62 TO STA. 14+32

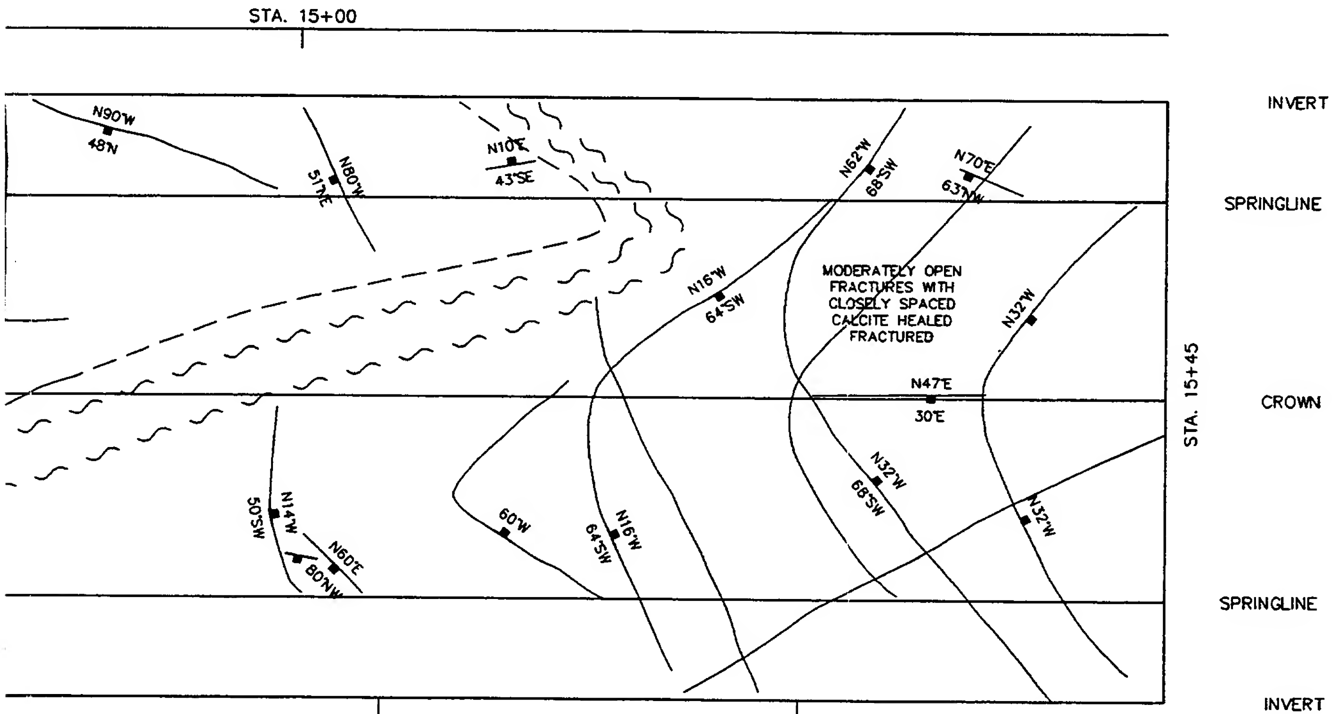
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

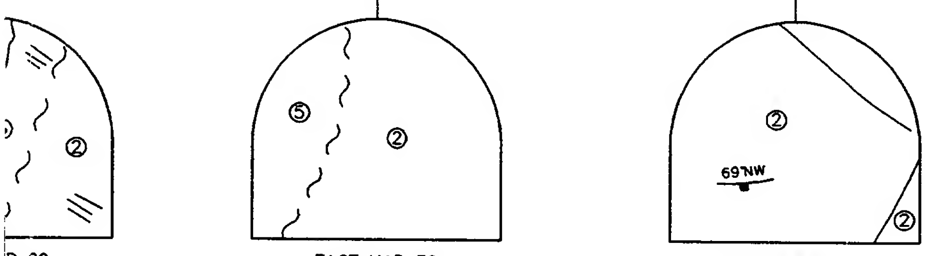
SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CK. BY:	GEOL. BY:	FILE No.:
ERE		CEC	PLATE 33



STA. 14+50
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 14+28
N25°E
70°SE
N85°E
46°SE
N17°E
64°SE
MODERATELY TO
HIGHLY FRACTURED
N85°E
46°SE
N47°E
42°NW
N58°E
80°SE
N90°W
48°N
INTENSELY
FRACTURED
N90°W
45°SW
N55°W
48°SW
N85°E
46°NE
60°
60°
60°
60°W
56°N
FACE MAP 27
(FIELD MAP 71)
FACE MAP 28
(FIELD MAP 70)
FACE MAP 29
(FIELD MAP 69)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
STA. 19+00
STA. 20+00
N
PLAN
NOT TO SCALE





P 29
P 69)

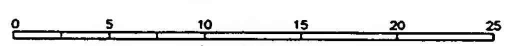
FACE MAP 30
(FIELD MAP 68)

FACE MAP 31
(FIELD MAP 67)

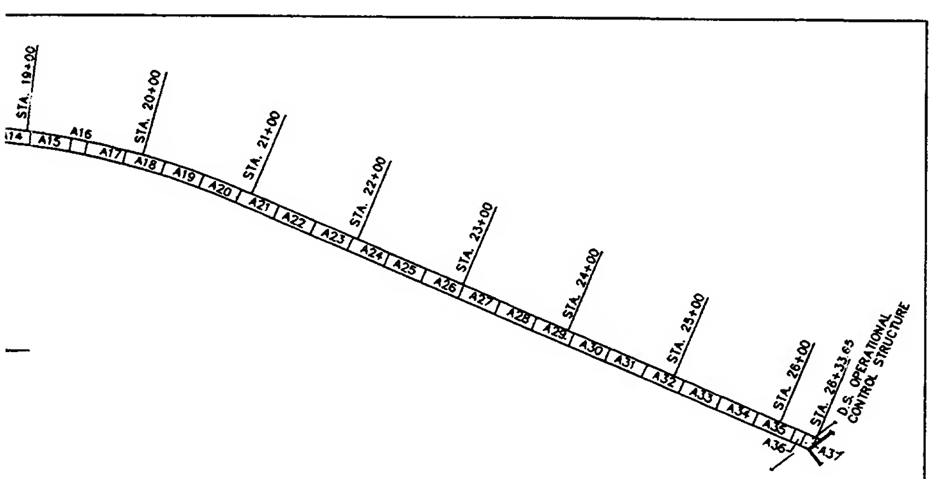
NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:



(SCALE IN FEET)

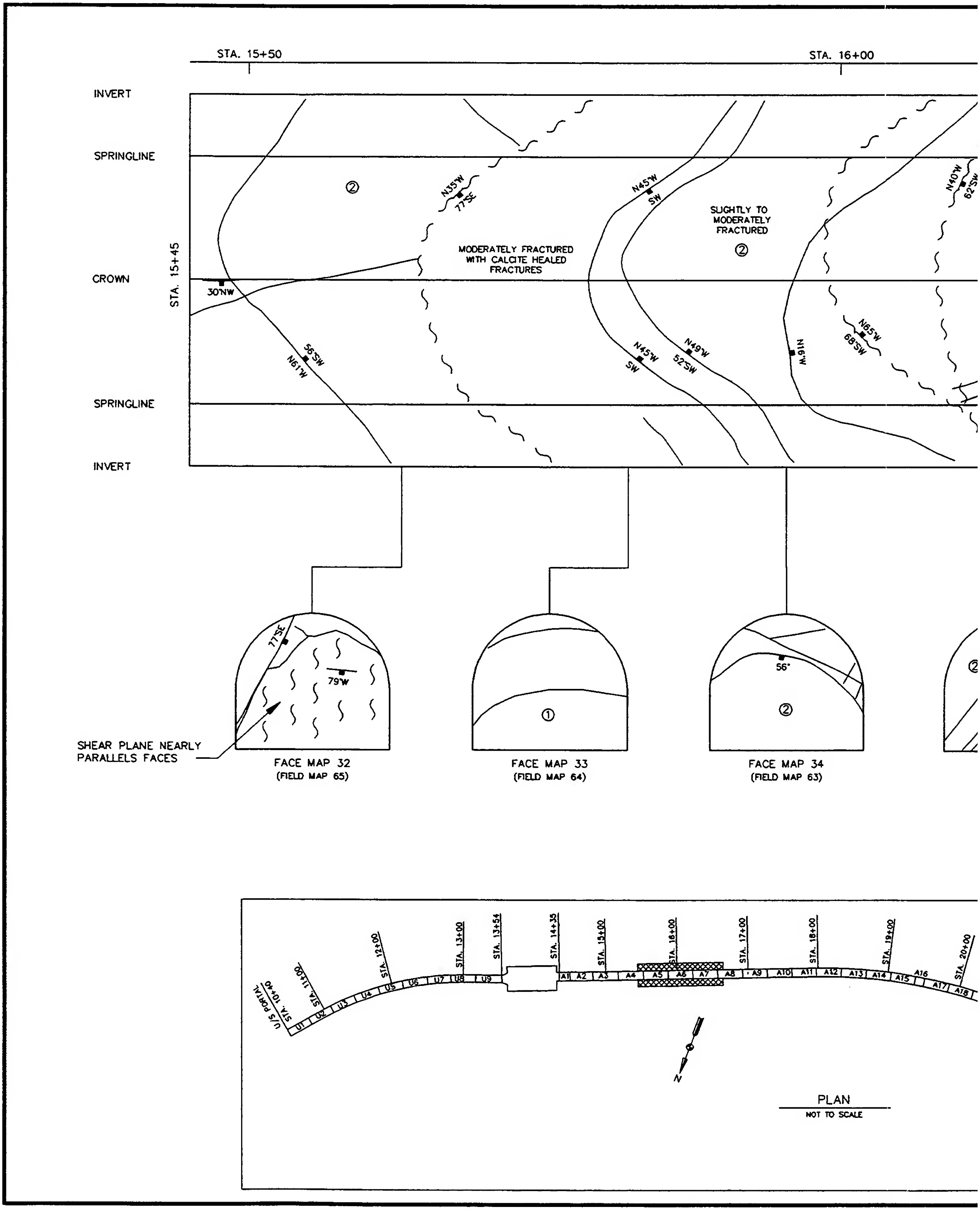


LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

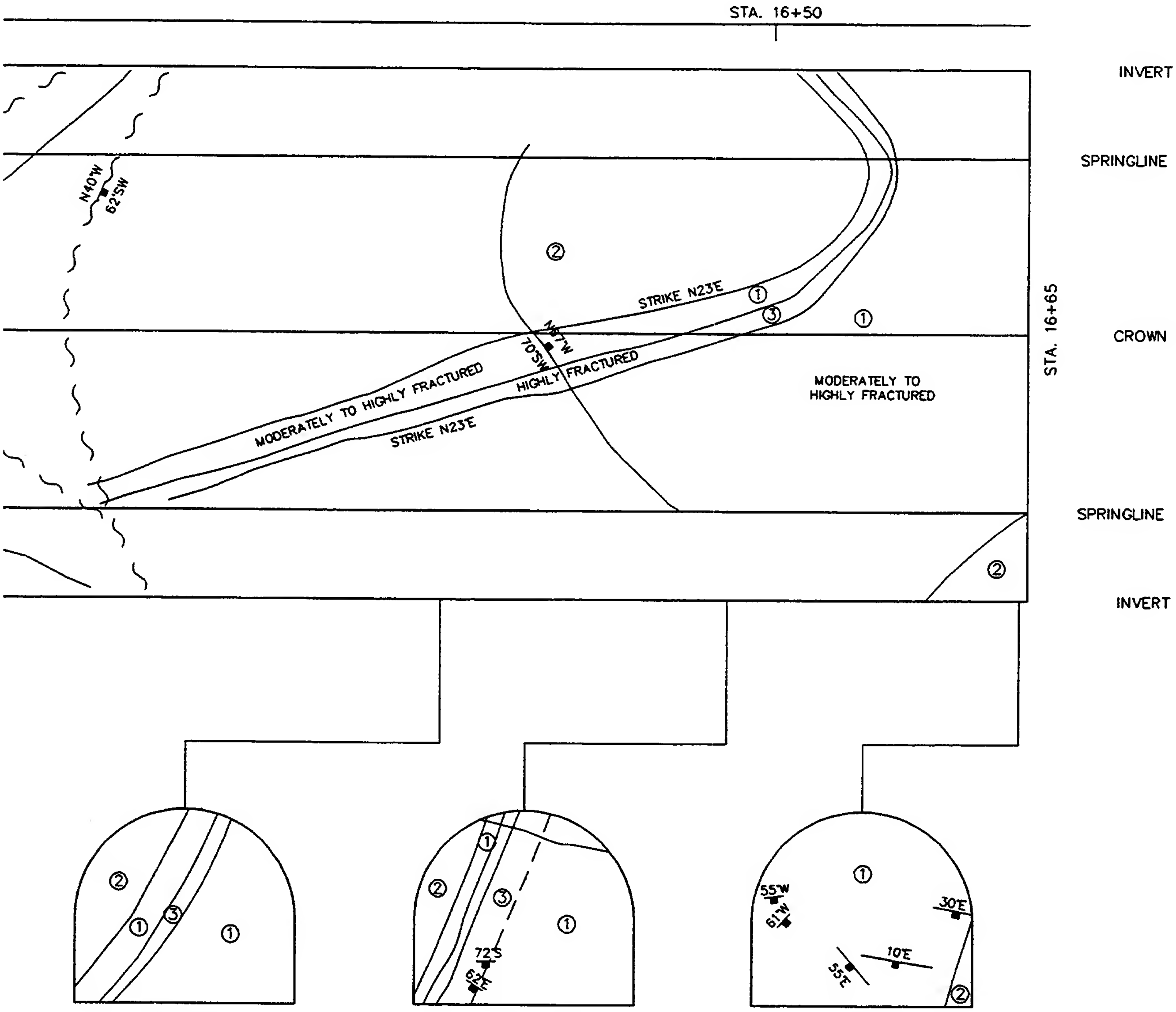
OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 14+28 TO STA. 15+45

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:		APPROVED:	
Robert L. Jarrett for CARL E. COLE, RESIDENT GEOLOGIST		PAUL M. PARSONEAULT, RESIDENT ENGINEER	
DR. BY: ERE	CK. BY:	GEOL. BY: CEC	FILE No.: PLATE 34



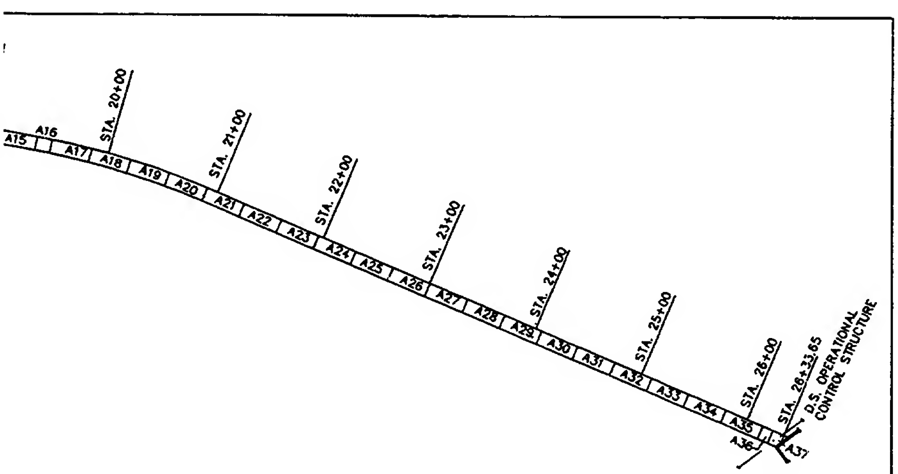
STA. 15+50
STA. 16+00
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 15+45
30°NW
N61°W
56°SW
N35°W
77°SE
MODERATELY FRACTURED WITH CALCITE HEALED FRACTURES
N45°W
SW
SLIGHTLY TO MODERATELY FRACTURED
N45°W
SW
N49°W
52°SW
N16°W
N65°W
68°SW
N40°W
62°SW
77°SE
79°W
56°
SHEAR PLANE NEARLY PARALLELS FACES
FACE MAP 32
(FIELD MAP 65)
FACE MAP 33
(FIELD MAP 64)
FACE MAP 34
(FIELD MAP 63)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
STA. 19+00
STA. 20+00
U1 U2 U3 U4 U5 U6 U7 U8 U9
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18
N
PLAN
NOT TO SCALE



FACE MAP 35
(FIELD MAP 61)

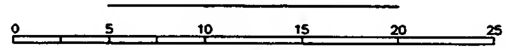
FACE MAP 36
(FIELD MAP 60)

FACE MAP 37
(FIELD MAP 59)



NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:



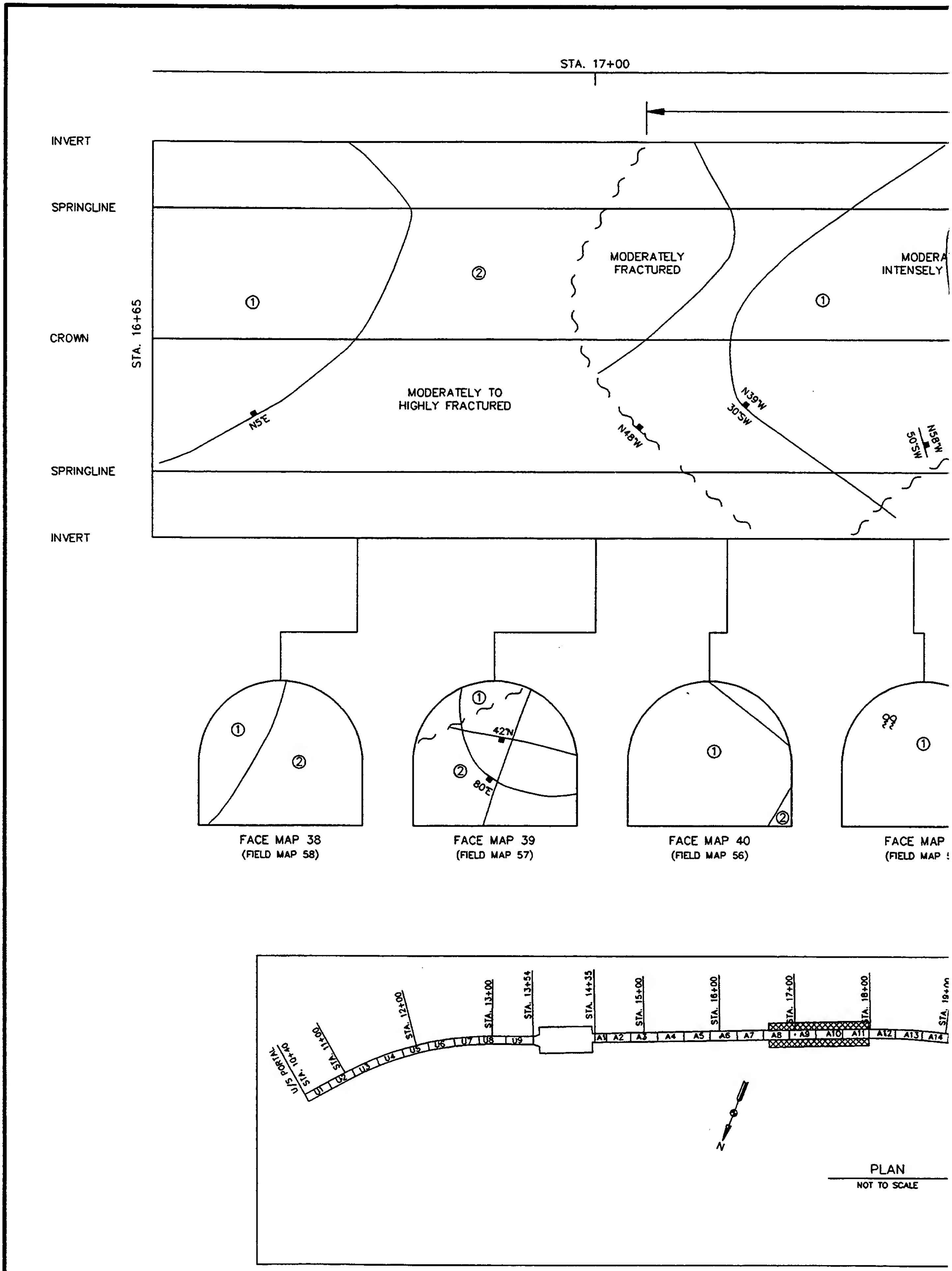
(SCALE IN FEET)

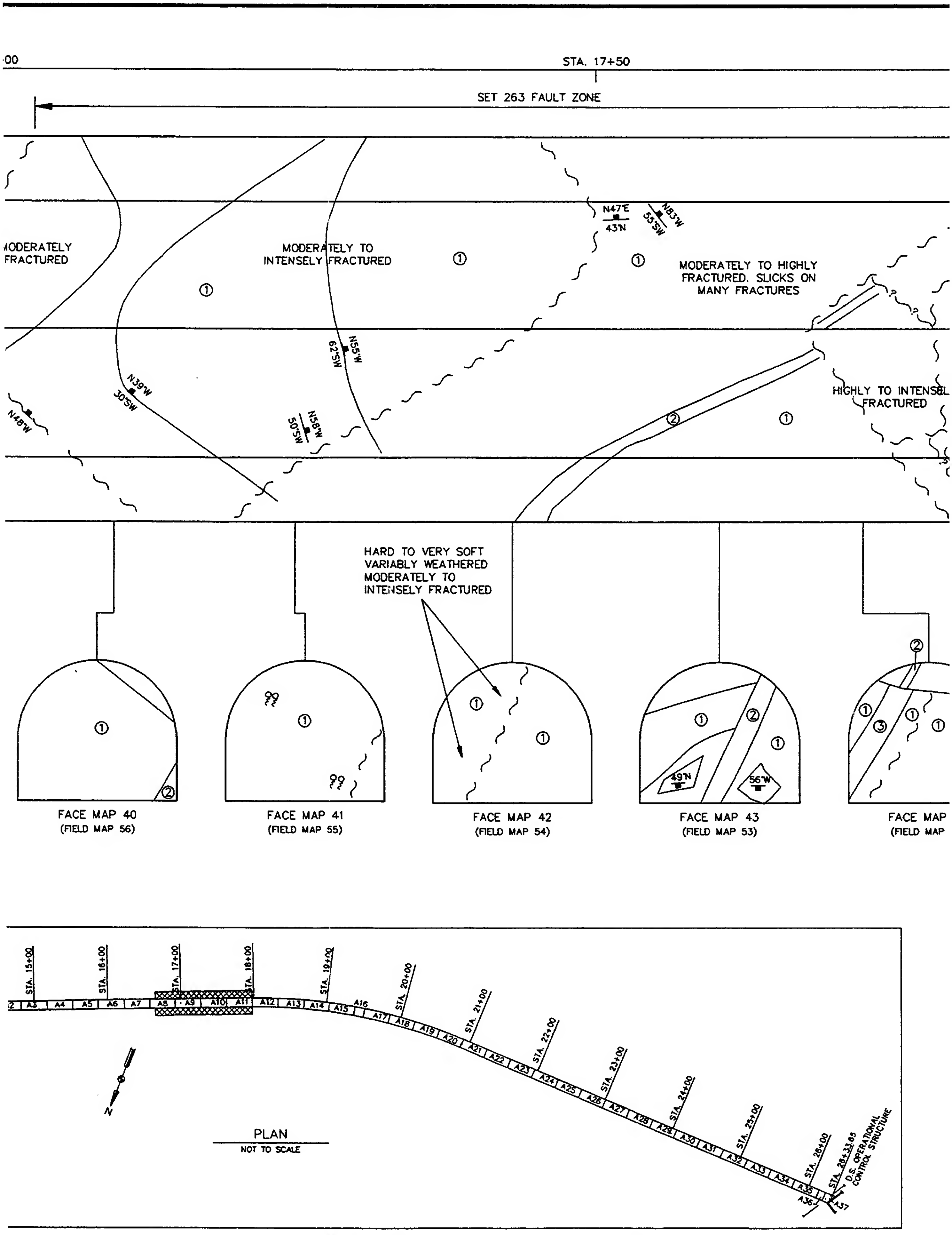
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 15+45 TO STA. 16+65

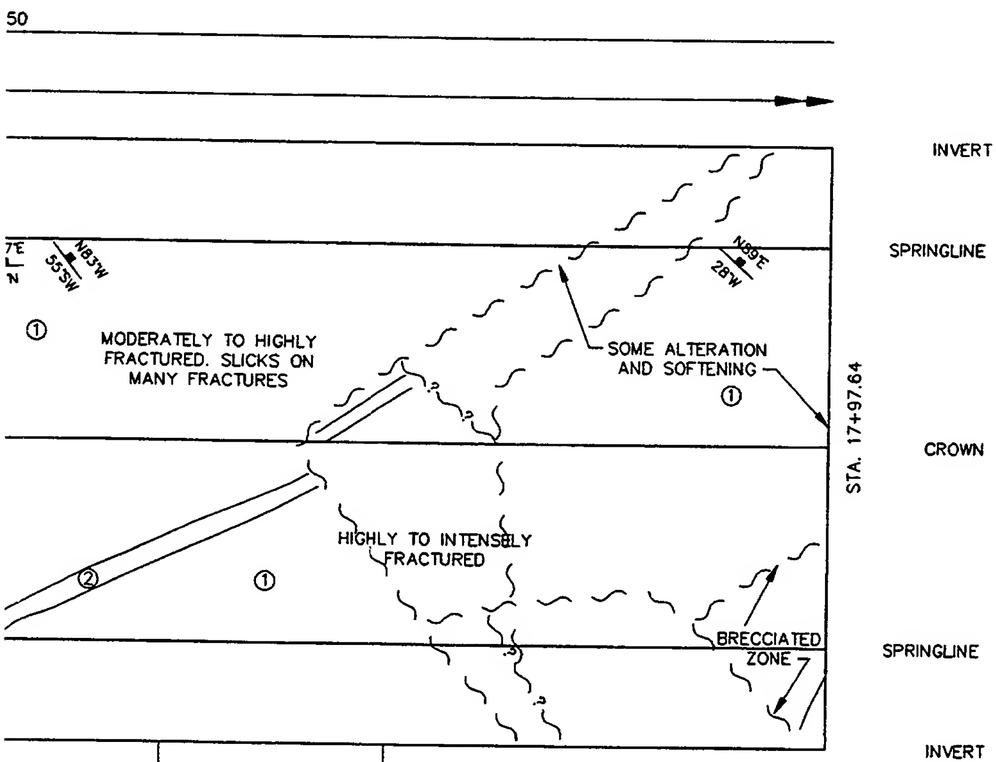
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

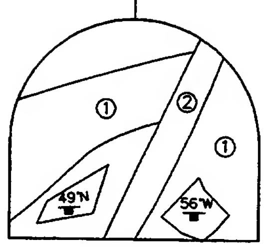
SUBMITTED: Robert L. Trent for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
ERE		CEC	PLATE 35


STA. 17+00
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 16+65
MODERATELY FRACTURED
MODERATELY TO HIGHLY FRACTURED
MODERA
INTENSELY
N5°E
N48°W
N39°W
30°SW
N58°W
50°SW
42°N
80°E
FACE MAP 38
(FIELD MAP 58)
FACE MAP 39
(FIELD MAP 57)
FACE MAP 40
(FIELD MAP 56)
FACE MAP
(FIELD MAP
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
STA. 19+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
N
PLAN
NOT TO SCALE

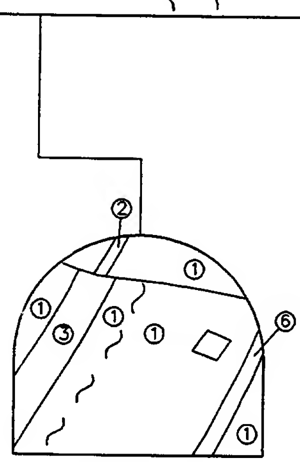


·00
STA. 17+50
SET 263 FAULT ZONE
MODERATELY FRACTURED
MODERATELY TO INTENSELY FRACTURED
MODERATELY TO HIGHLY FRACTURED. SLICKS ON MANY FRACTURES
HIGHLY TO INTENSELY FRACTURED
N47°E 43°N
N83°W 55°SW
N55°W 62°SW
N39°W 30°SW
N48°W
N58°W 50°SW
HARD TO VERY SOFT VARIABLY WEATHERED MODERATELY TO INTENSELY FRACTURED
49°N
56°W
FACE MAP 40
(FIELD MAP 56)
FACE MAP 41
(FIELD MAP 55)
FACE MAP 42
(FIELD MAP 54)
FACE MAP 43
(FIELD MAP 53)
FACE MAP
(FIELD MAP
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
STA. 19+00
STA. 20+00
STA. 21+00
STA. 22+00
STA. 23+00
STA. 24+00
STA. 25+00
STA. 26+00
STA. 26+33.85
D.S. OPERATIONAL CONTROL STRUCTURE
A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18 A19 A20 A21 A22 A23 A24 A25 A26 A27 A28 A29 A30 A31 A32 A33 A34 A35 A36 A37
N
PLAN
NOT TO SCALE





FACE MAP 43
(FIELD MAP 53)

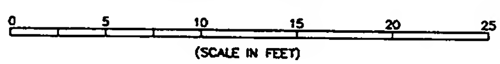


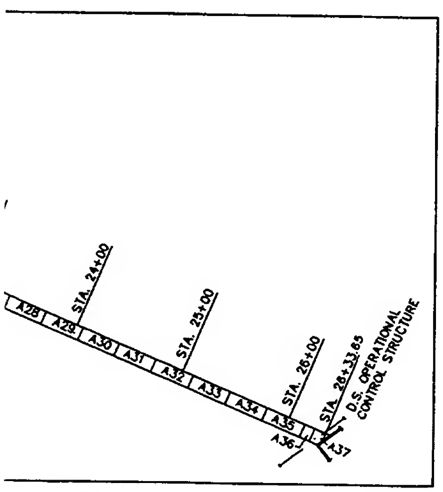
FACE MAP 44
(FIELD MAP 52)

NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:





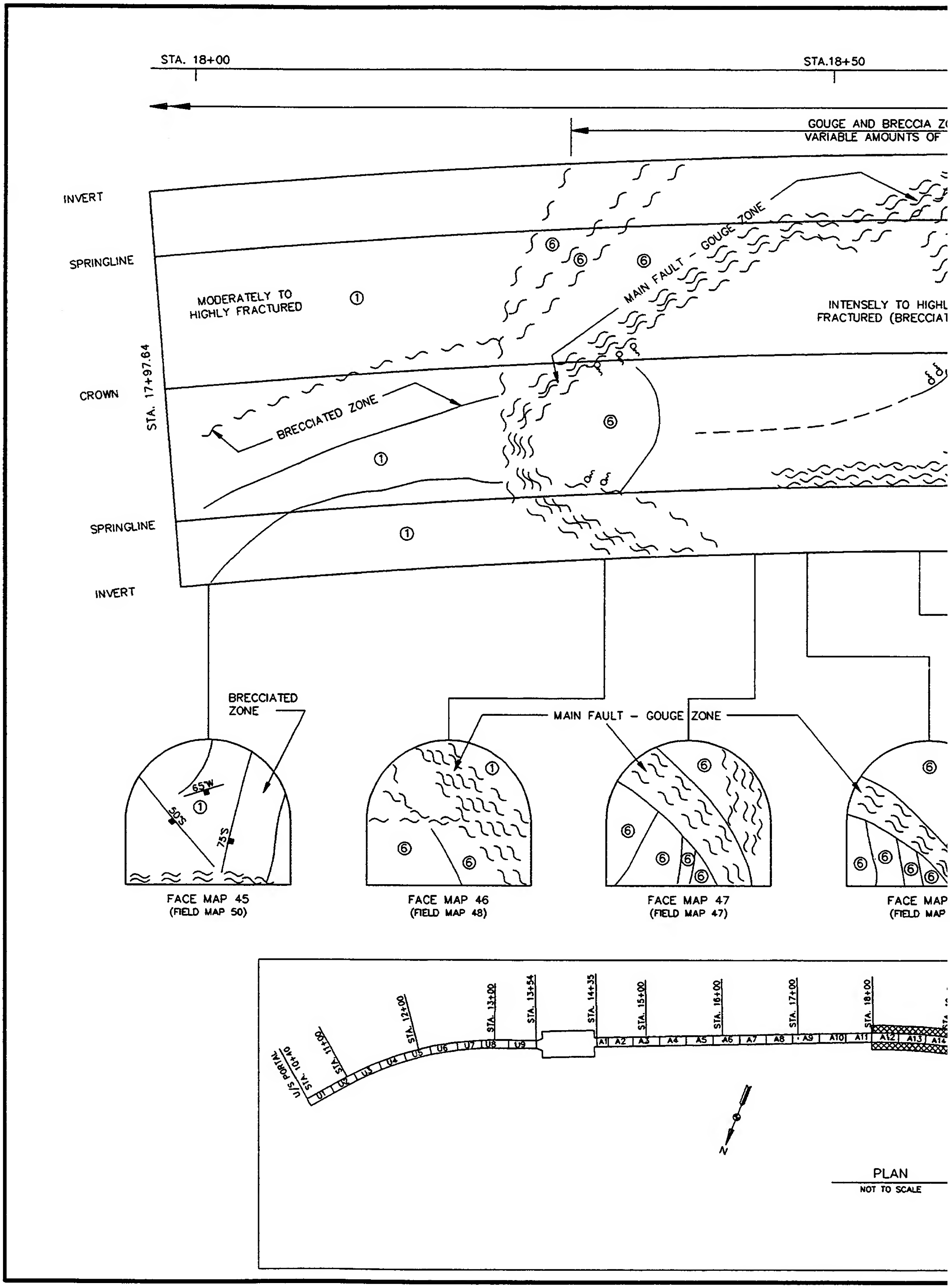
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS

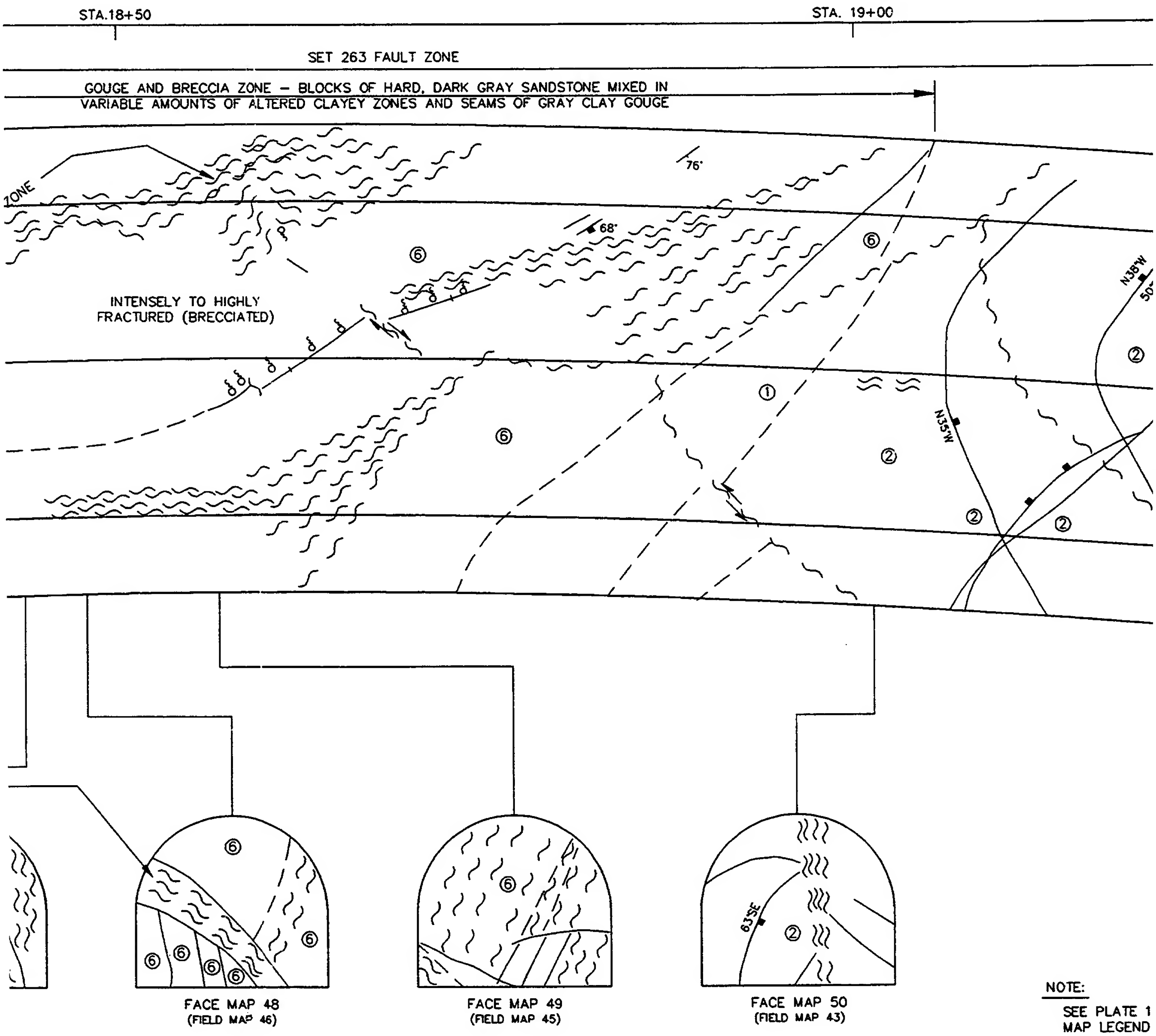
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 16+65 TO STA. 17+97.64

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

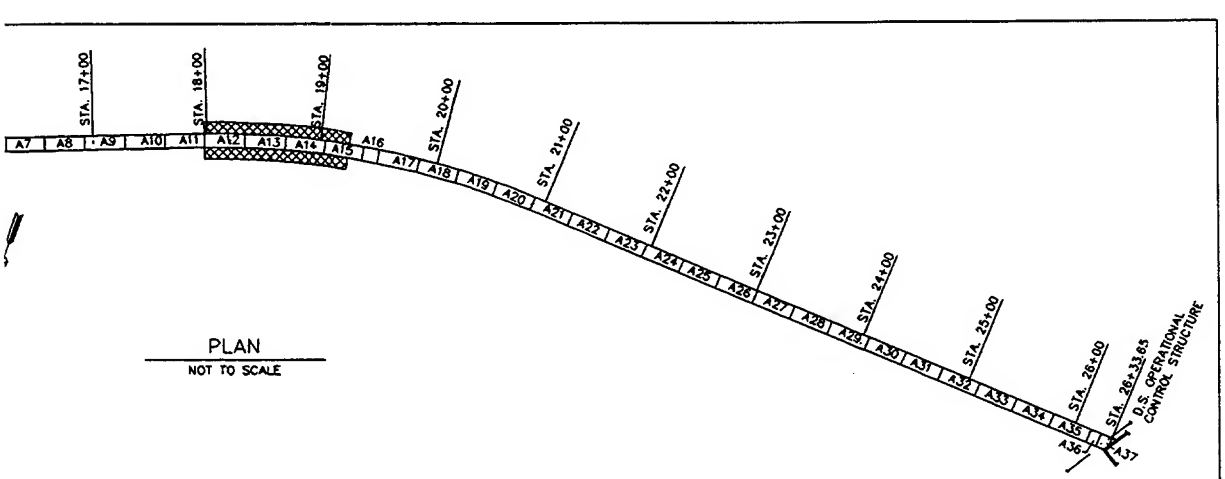
SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	CK. BY:	GEOL. BY: CEC	FILE No: PLATE 36



STA. 18+00
STA.18+50
GOUGE AND BRECCIA Z
VARIABLE AMOUNTS OF
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 17+97.64
MODERATELY TO
HIGHLY FRACTURED
MAIN FAULT - GOUGE ZONE
INTENSELY TO HIGHL
FRACTURED (BRECCIAT
BRECCIATED ZONE
BRECCIATED
ZONE
MAIN FAULT - GOUGE ZONE
65°W
50°S
75°S
FACE MAP 45
(FIELD MAP 50)
FACE MAP 46
(FIELD MAP 48)
FACE MAP 47
(FIELD MAP 47)
FACE MAP
(FIELD MAP
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
N
PLAN
NOT TO SCALE



NOTE:
SEE PLATE 1
MAP LEGEND



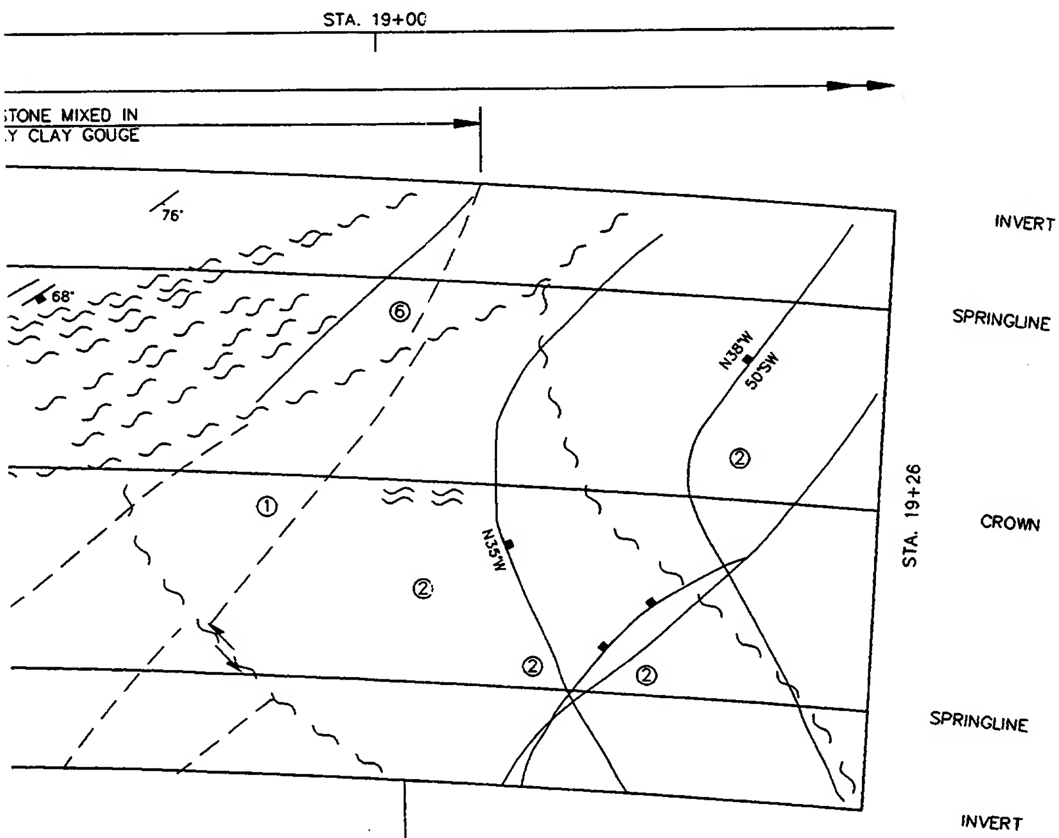
PLAN
NOT TO SCALE

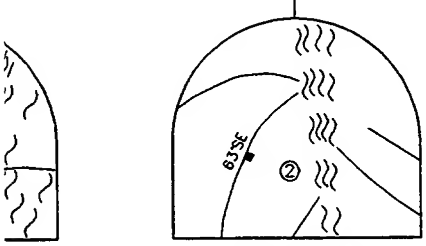
0 5

GEOLOGIC

SUBMITTED:
CARL E.

ERE



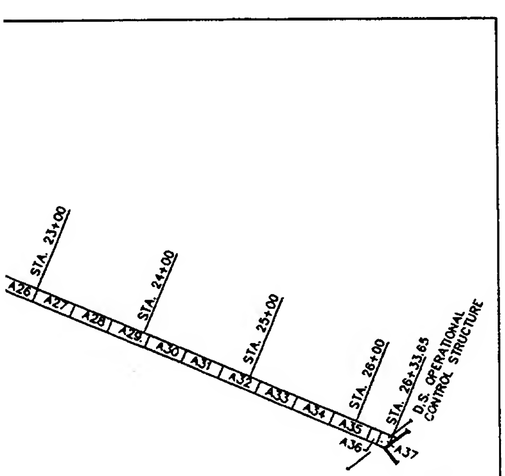


FACE MAP 50
(FIELD MAP 43)

NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25
(SCALE IN FEET)



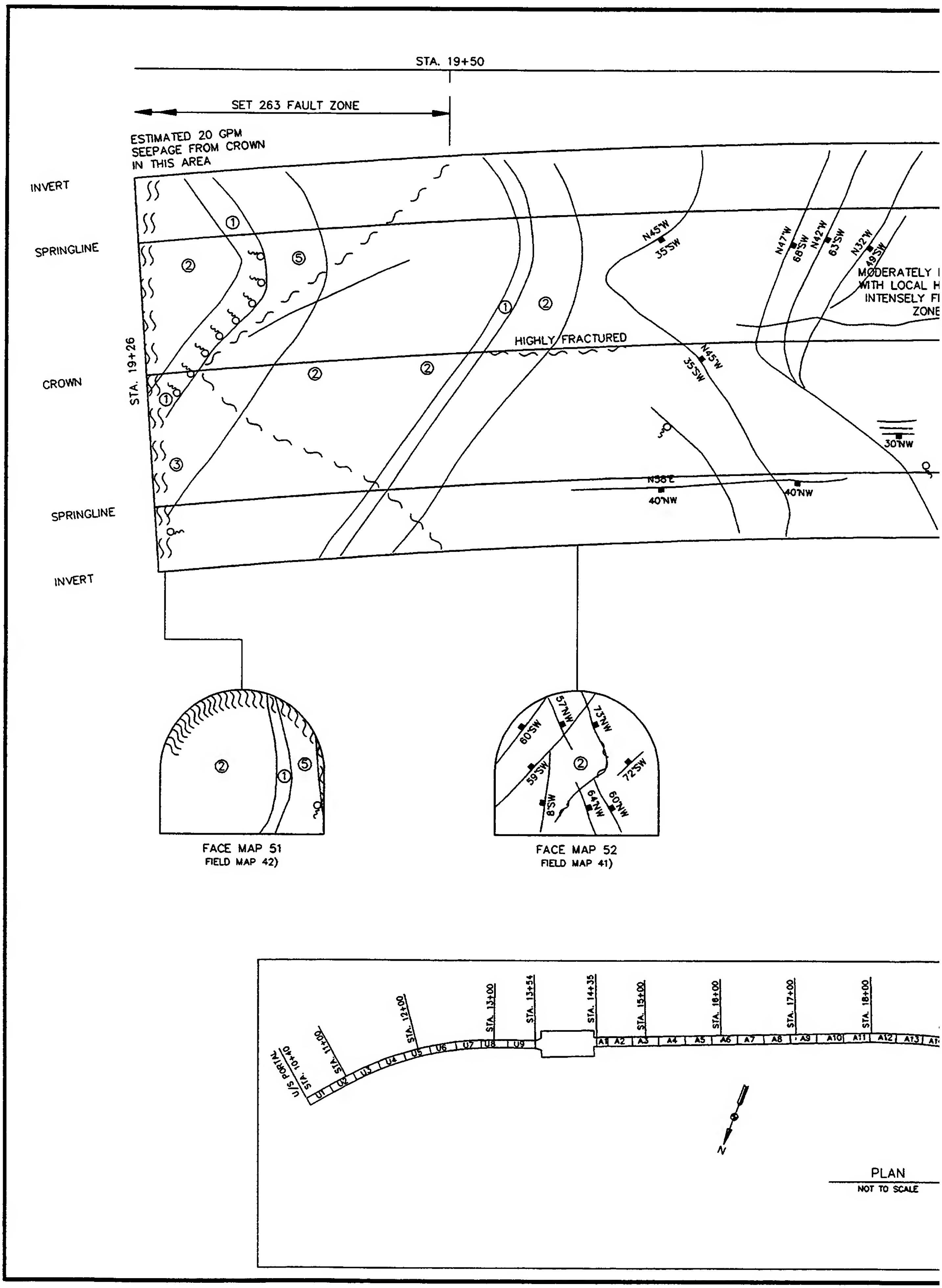
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 17+97.64 TO STA. 19+26

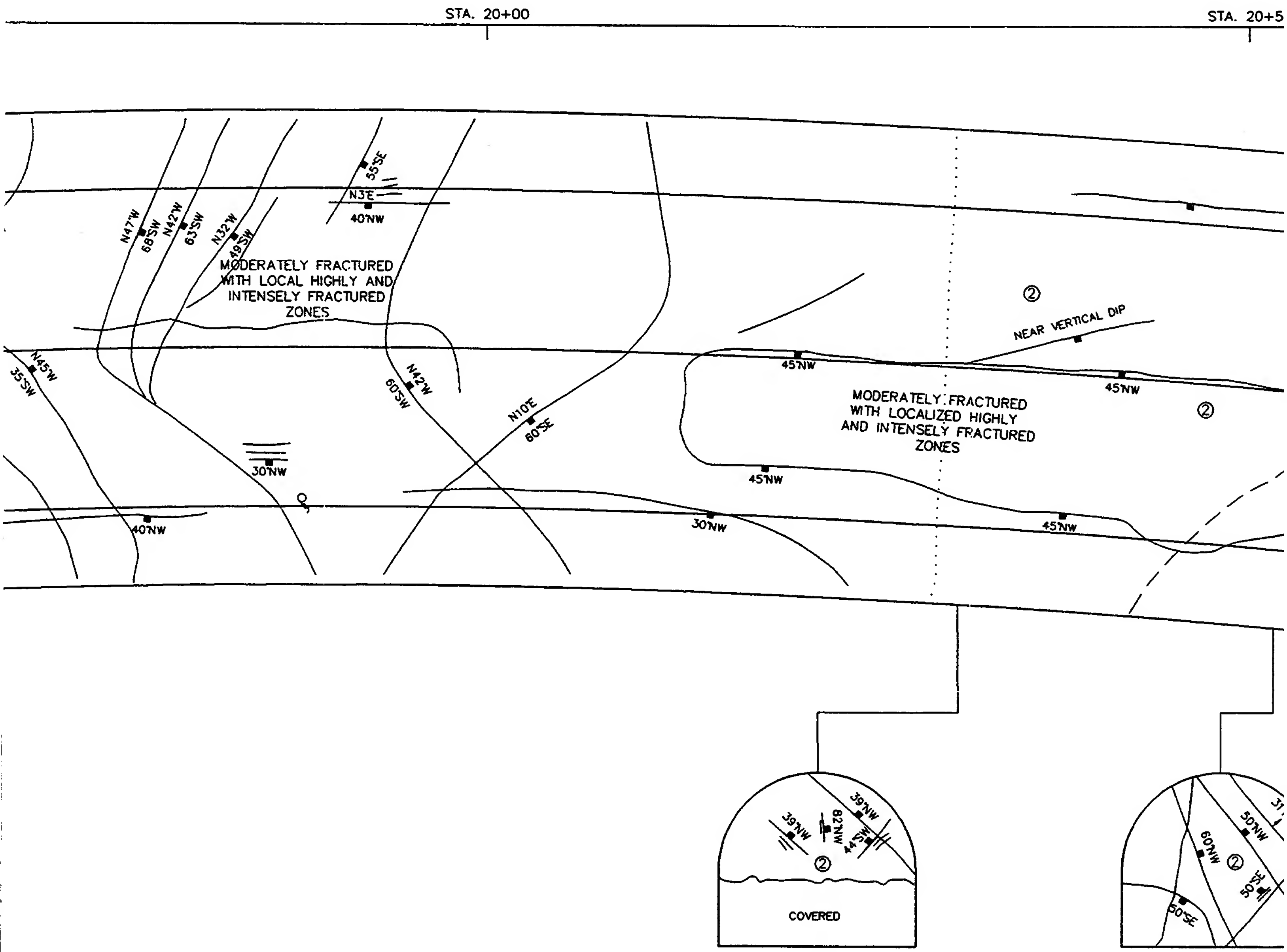
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	GEOL. BY:	FILE No:
ERE		CEC	PLATE 37



STA. 19+50
SET 263 FAULT ZONE
ESTIMATED 20 GPM
SEEPAGE FROM CROWN
IN THIS AREA
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 19+26
HIGHLY FRACTURED
N45°W
35°SW
N47°W
68°SW
N42°W
63°SW
N32°W
49°SW
MODERATELY I
WITH LOCAL H
INTENSELY FI
ZONE
N45°W
35°SW
30°NW
N58°E
40°NW
40°NW
57°NW
73°NW
60°SW
59°SW
72°SW
8°SW
64°NW
60°NW
FACE MAP 51
FIELD MAP 42)
FACE MAP 52
FIELD MAP 41)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
N
PLAN
NOT TO SCALE

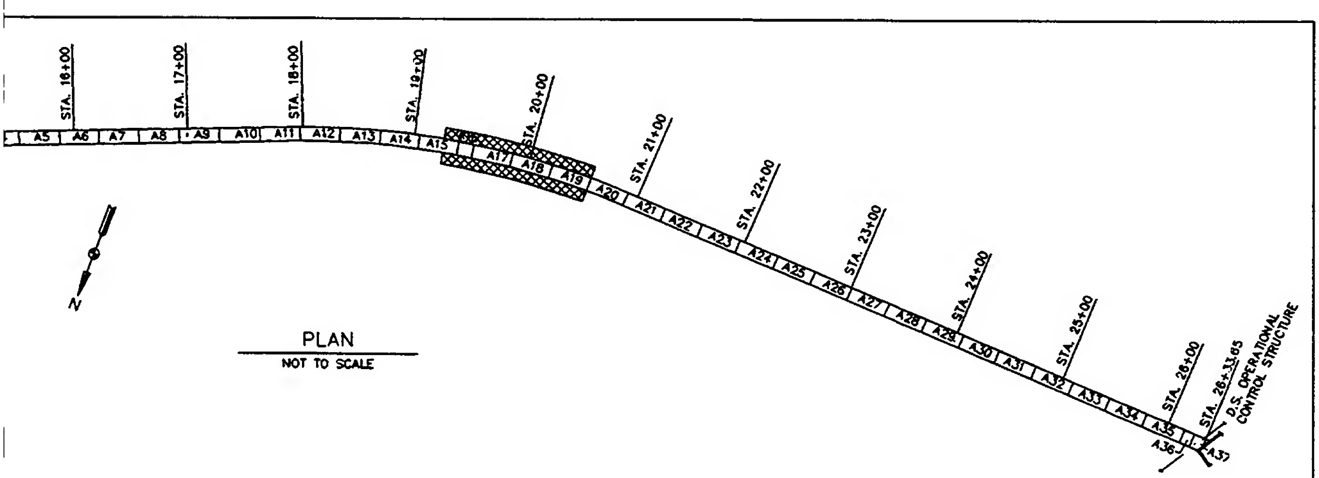


FACE MAP 53
FIELD MAP 40)

FACE MAP 54
FIELD MAP 39)

NOTE:

SEE PLATE 11 FOR G
MAP LEGEND AND SY



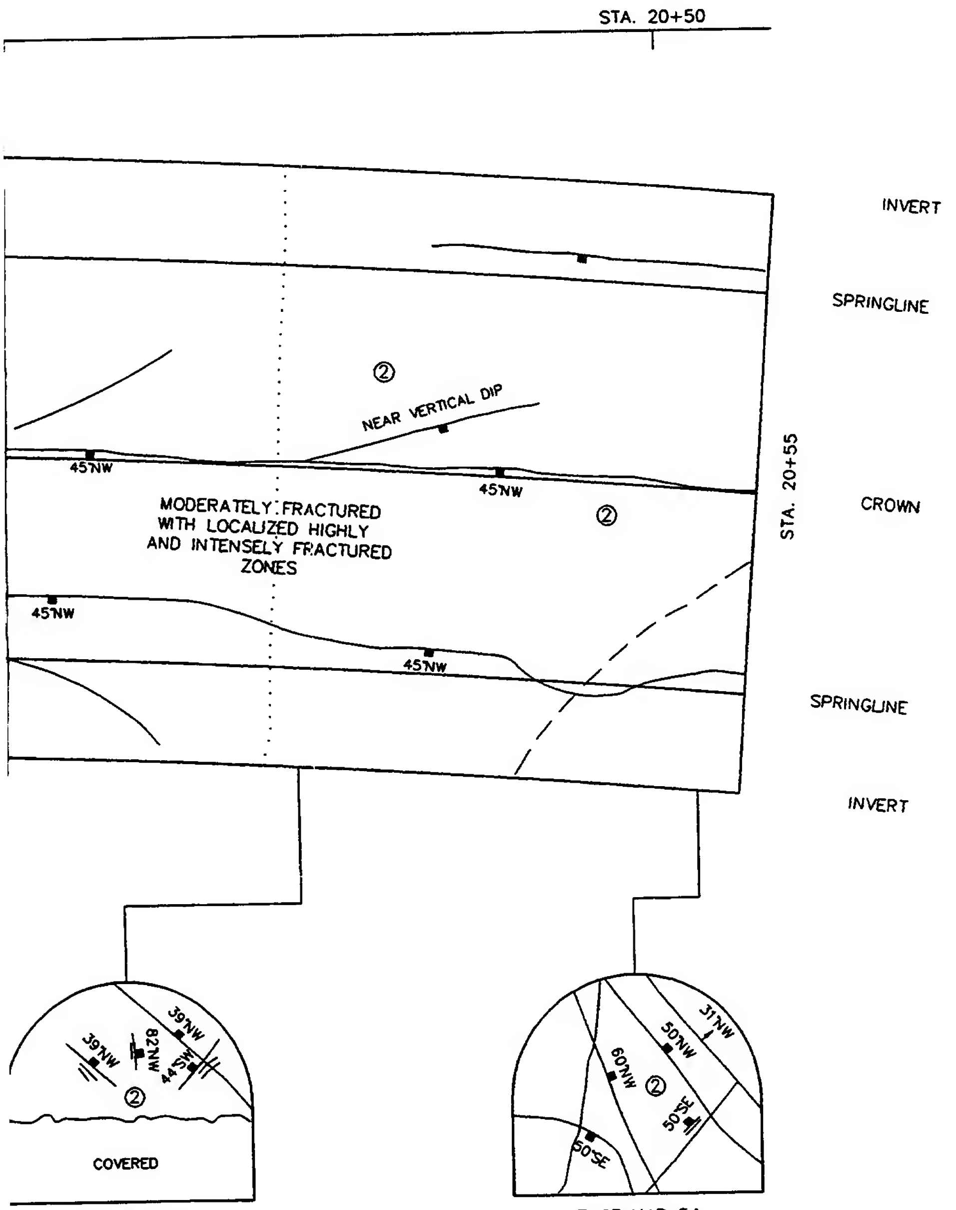
PLAN
NOT TO SCALE

GRA
0 5 10
(S

U
SALT LA
C
FLOOD
GEOLOGIC MAP S
DEPAR
SACRAMENTO
SAC

SUBMITTED:
Robert L. Treat
for CARL E. COLE
RESIDENT GEOLOGIST

ERE
CI

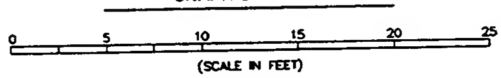


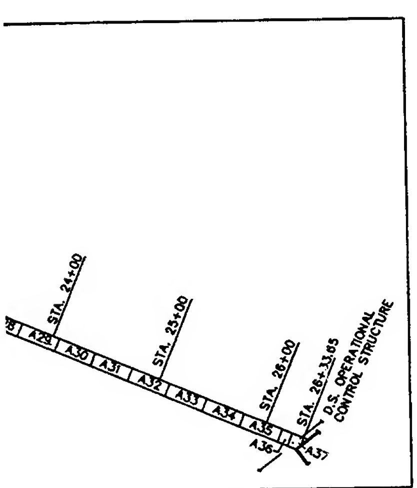
FACE MAP 53
FIELD MAP 40)

FACE MAP 54
FIELD MAP 39)

NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:



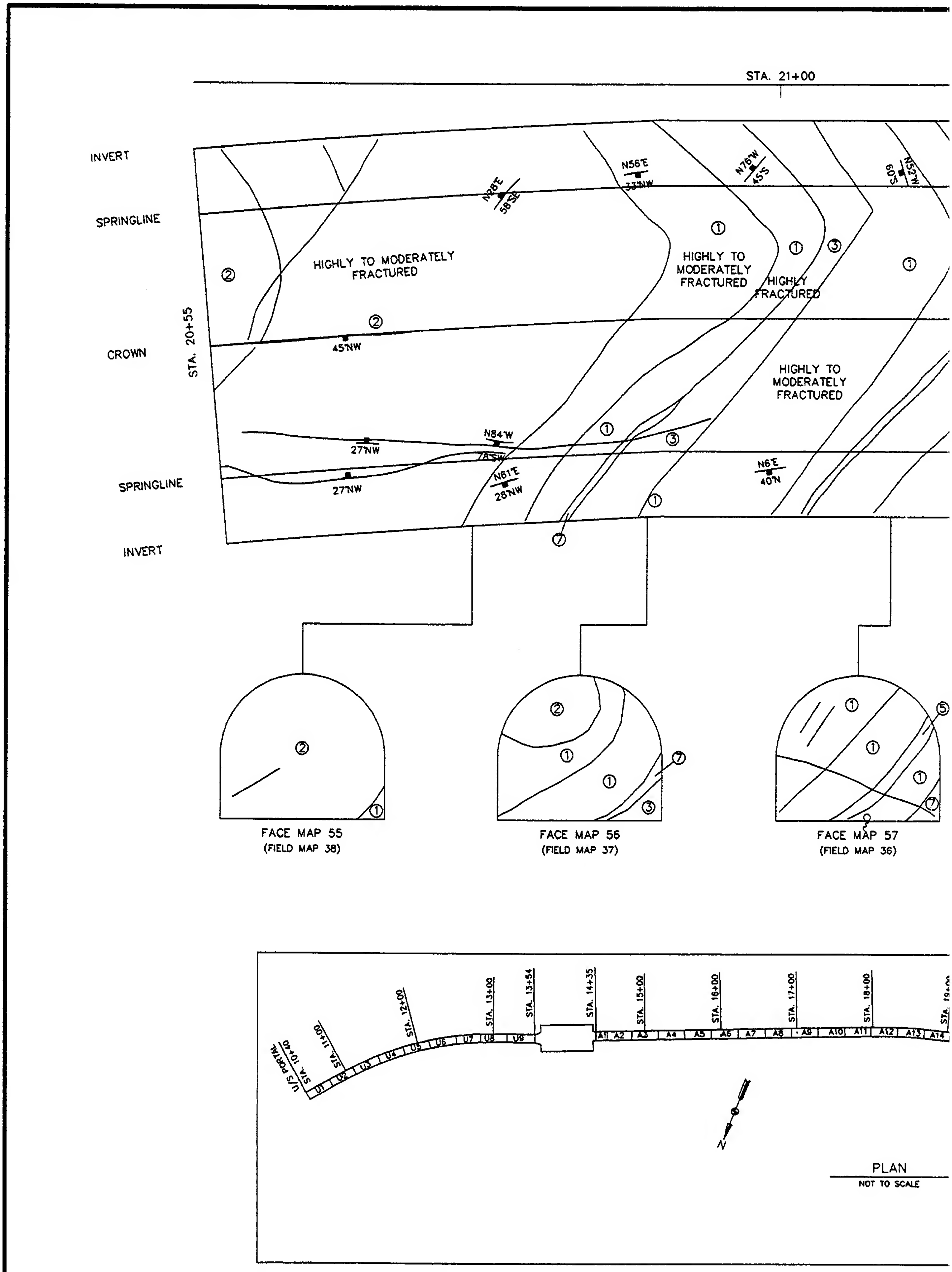


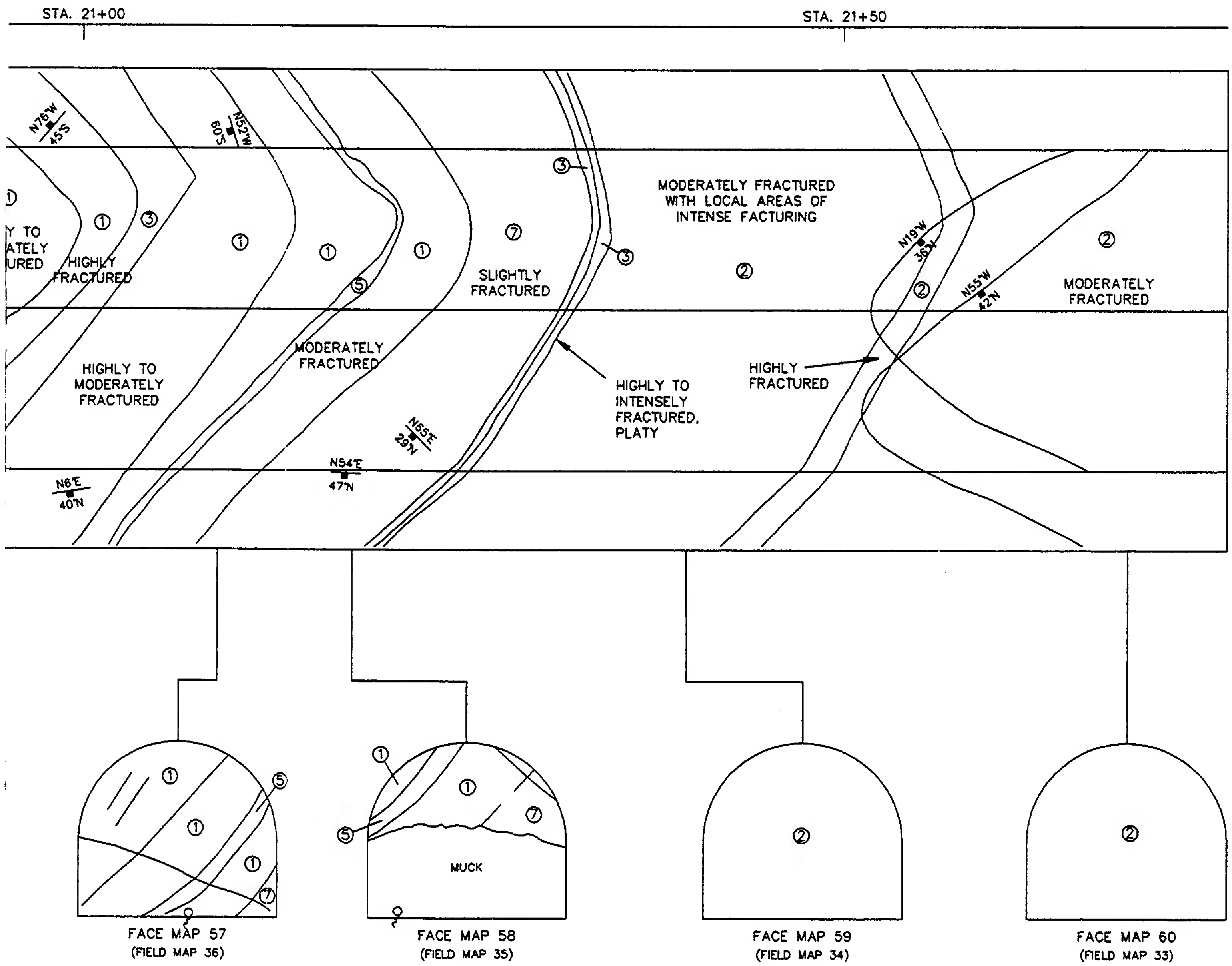
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 19+26 TO STA. 20+55

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

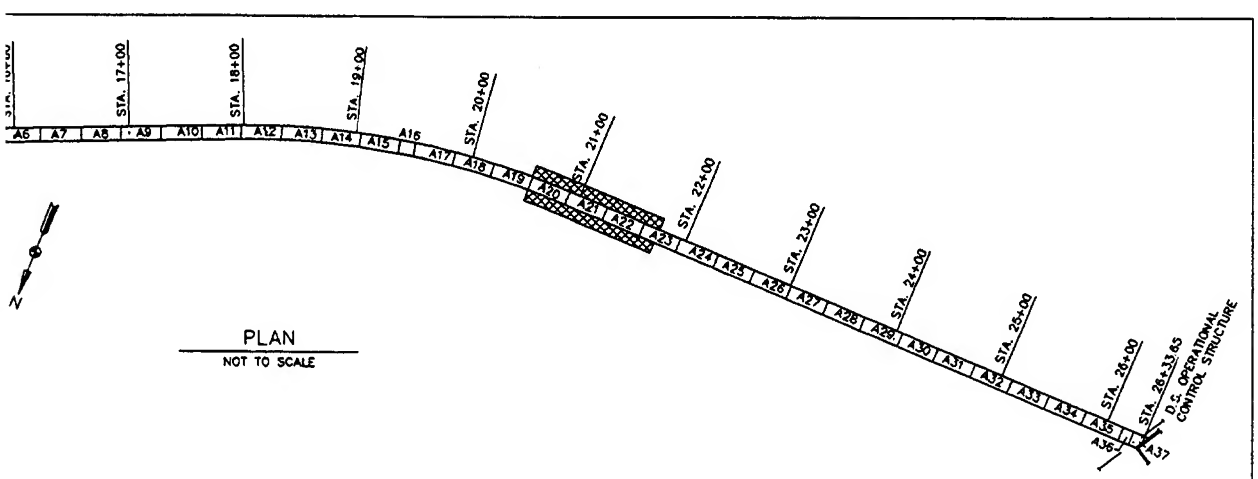
SUBMITTED:	APPROVED:
Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE NO.:
ERE		CEC	PLATE 38


STA. 21+00
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 20+55
HIGHLY TO MODERATELY FRACTURED
HIGHLY TO MODERATELY FRACTURED
HIGHLY FRACTURED
HIGHLY TO MODERATELY FRACTURED
N28°E 58°SE
N56°E 33°NW
N76°W 45°S
N52°W 60°S
45°NW
27°NW
27°NW
N84°W 78°SW
N61°E 28°NW
N6°E 40°N
FACE MAP 55
(FIELD MAP 38)
FACE MAP 56
(FIELD MAP 37)
FACE MAP 57
(FIELD MAP 36)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
N
PLAN
NOT TO SCALE



NOTE:
SEE PLATE 11 FOR GEOLOG
MAP LEGEND AND SYMBOLS



PLAN
NOT TO SCALE

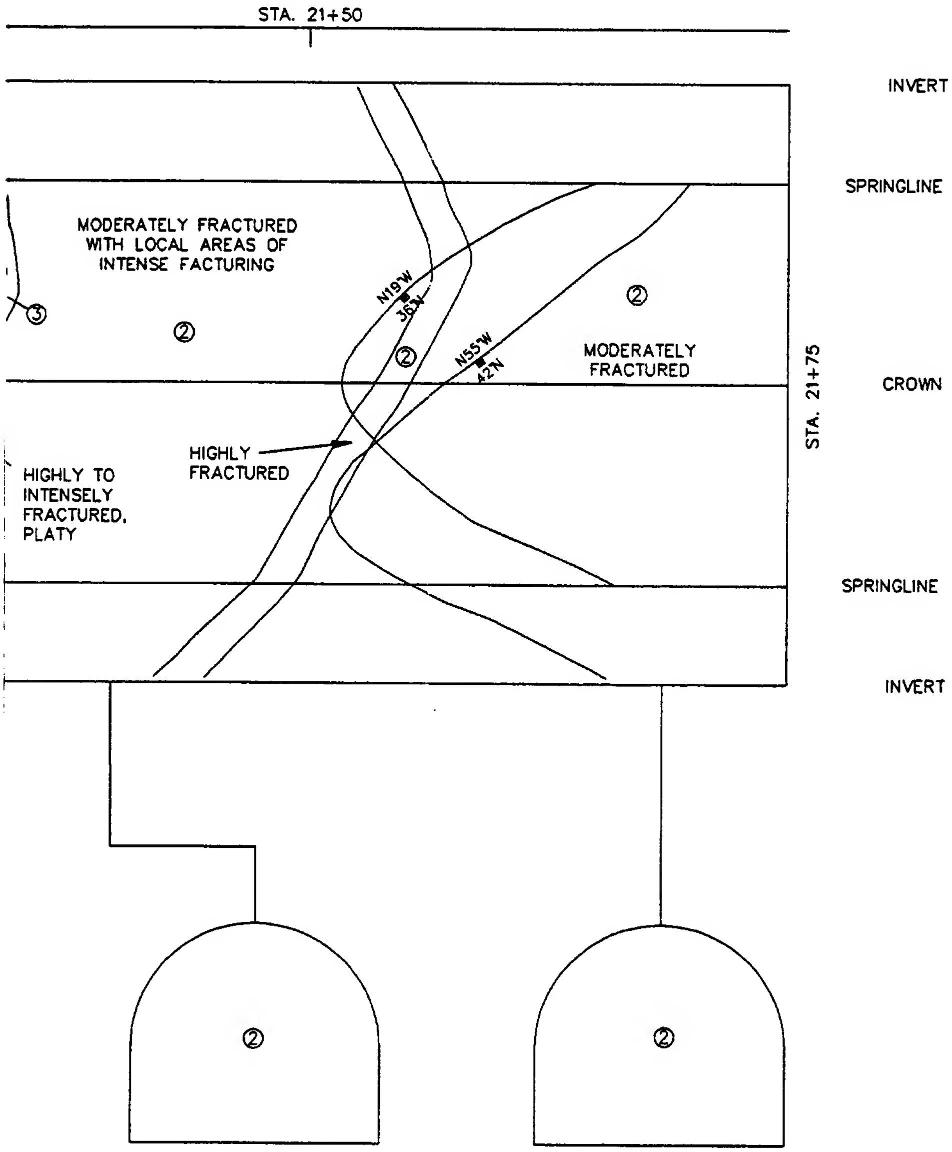
GRAPHIC S
0 5 10
(SCALE IN

LITTLE DEL
SALT LAKE CITY S
OUTLET
FLOOD CONTR
GEOLOGIC MAP STA. 2

DEPARTMENT O
SACRAMENTO DISTRICT, C
SACRAMENTO,

SUBMITTED:
CARL E. COLE
RESIDENT GEOLOGIST

ERE		CEC



FACE MAP 59
(FIELD MAP 34)

FACE MAP 60
(FIELD MAP 33)

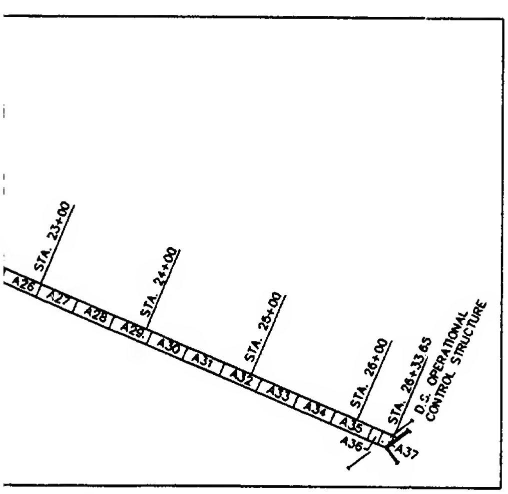
NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)



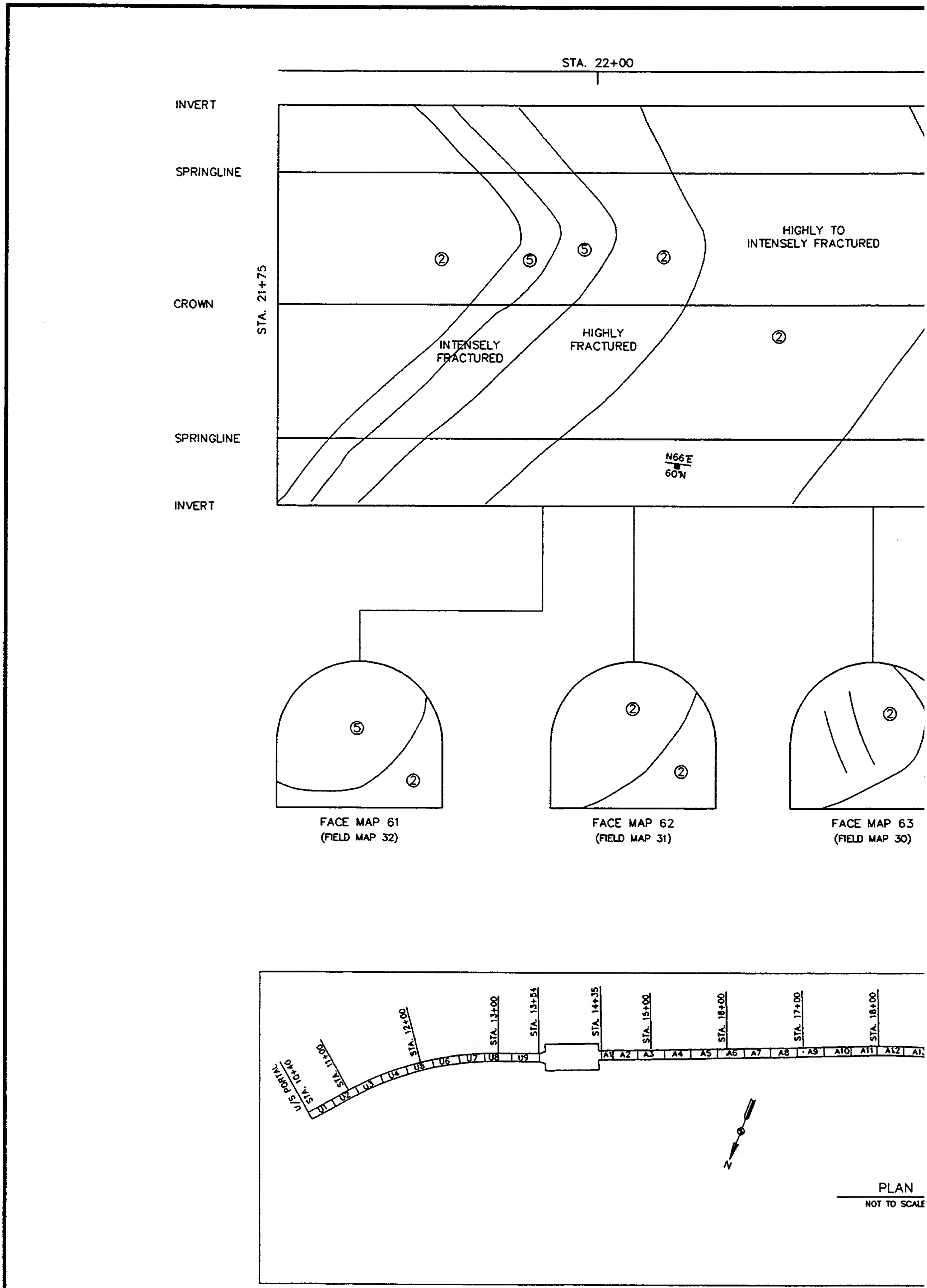
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS

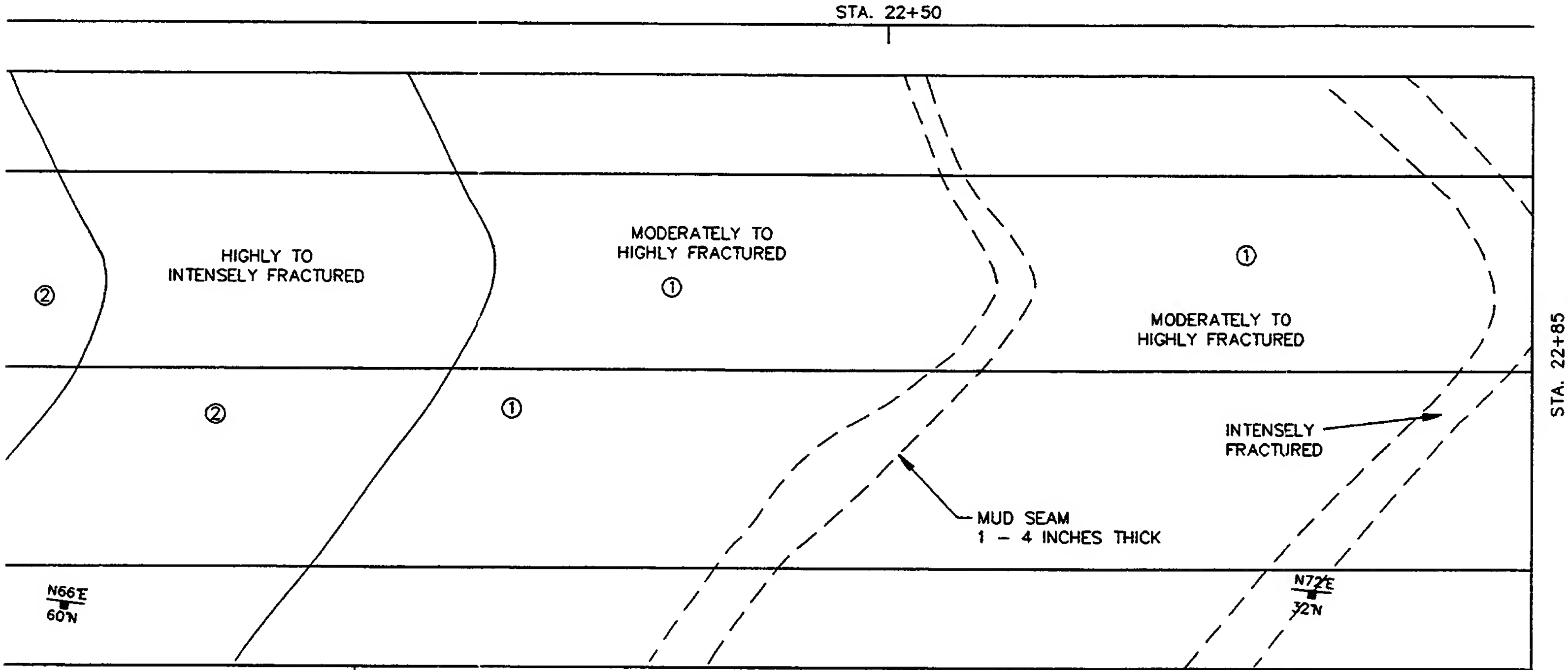
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 20+55 TO STA. 21+75

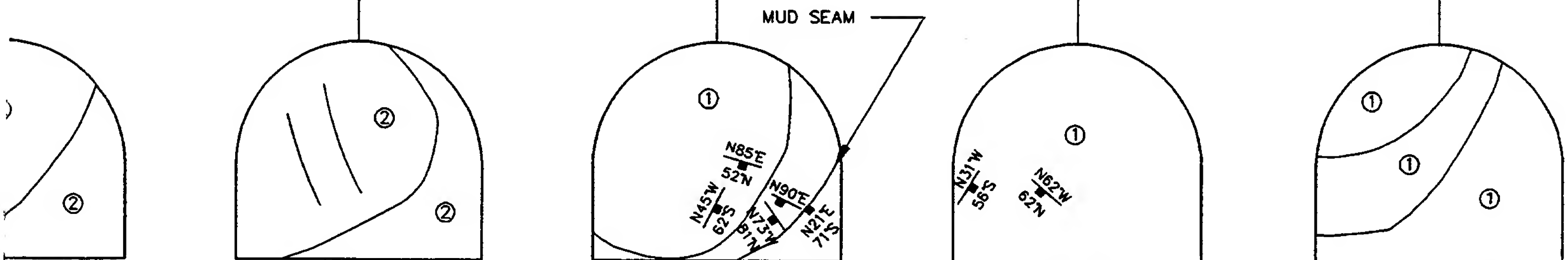
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:			APPROVED:
Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST			PAUL M. PARSONEAULT, RESIDENT ENGINEER
ERE		CEC	PLATE 39



STA. 22+00
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 21+75
②
⑤
⑤
②
HIGHLY TO INTENSELY FRACTURED
INTENSELY FRACTURED
HIGHLY FRACTURED
②
N66°E
60°N
⑤
②
②
②
②
FACE MAP 61
(FIELD MAP 32)
FACE MAP 62
(FIELD MAP 31)
FACE MAP 63
(FIELD MAP 30)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1 U2 U3 U4 U5 U6 U7 U8 U9
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12
N
PLAN
NOT TO SCALE





AP 62
AP 31)

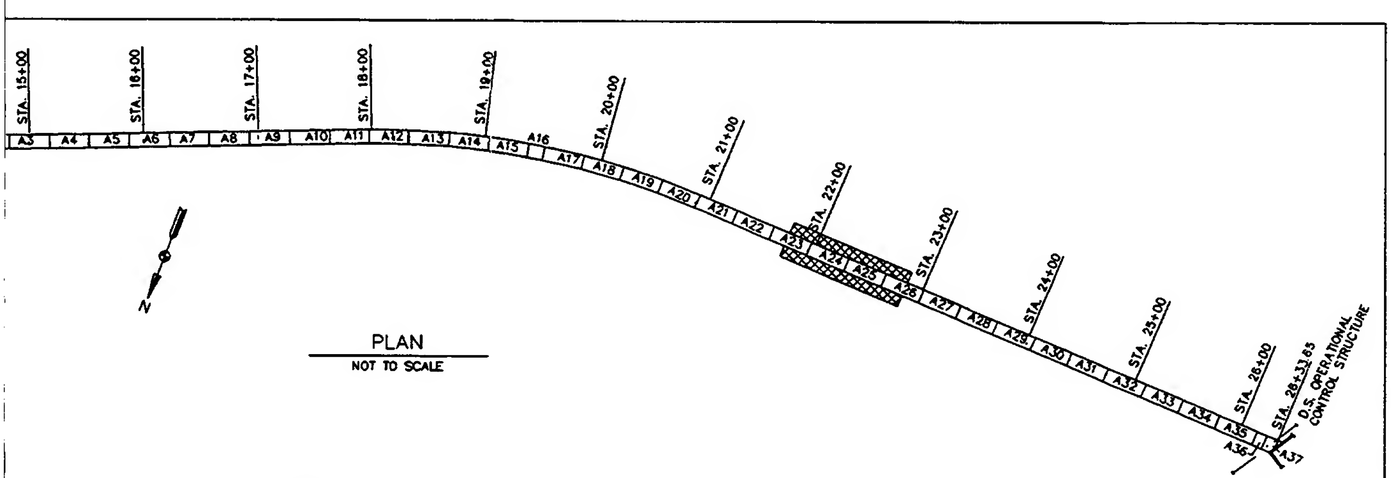
FACE MAP 63
(FIELD MAP 30)

FACE MAP 64
(FIELD MAP 29)

FACE MAP 65
(FIELD MAP 28)

FACE MAP 66
(FIELD MAP 27)

NOTE:
SEE PLATE
MAP LEGEND



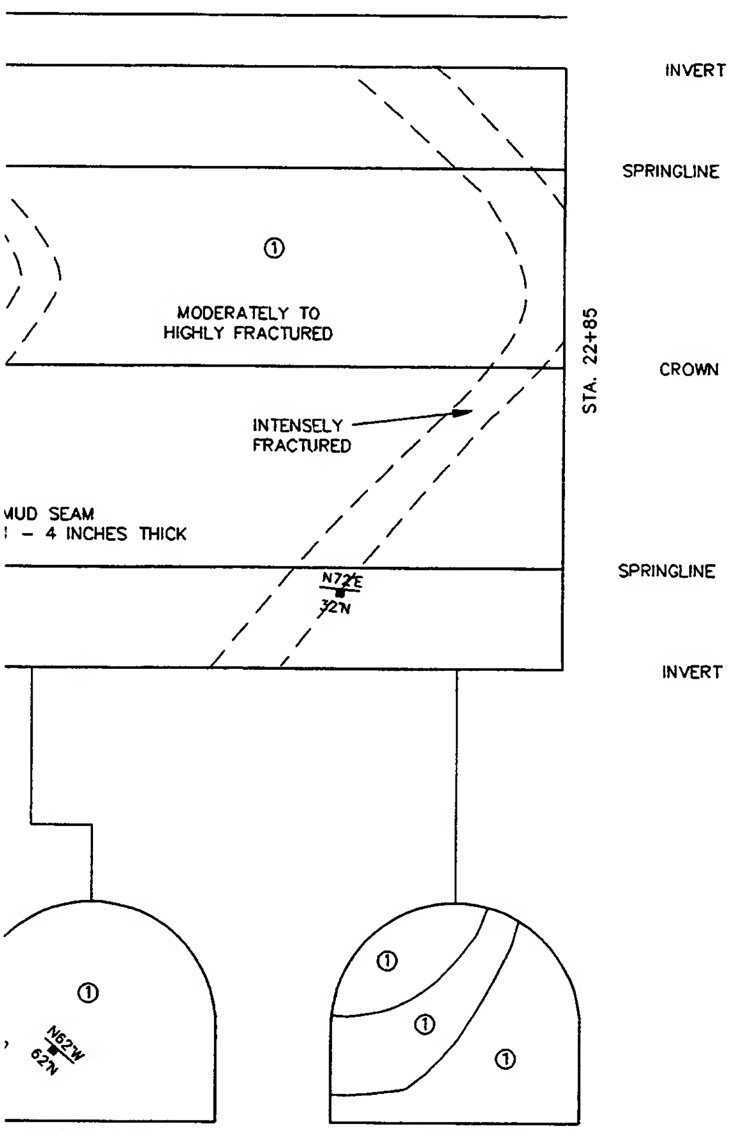
PLAN
NOT TO SCALE

0 5

GEOLOGIC

SUBMITTED:
CARL E.

ERE

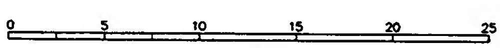


FACE MAP 65
(FIELD MAP 28)

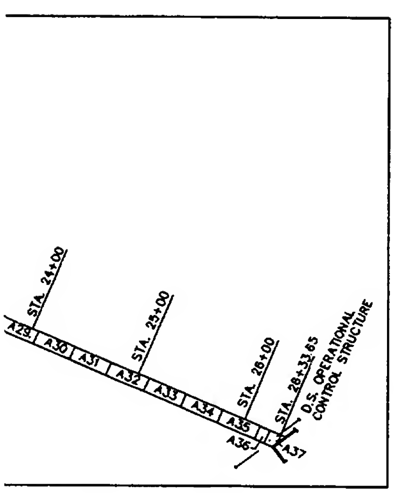
FACE MAP 66
(FIELD MAP 27)

NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALES:



(SCALE IN FEET)



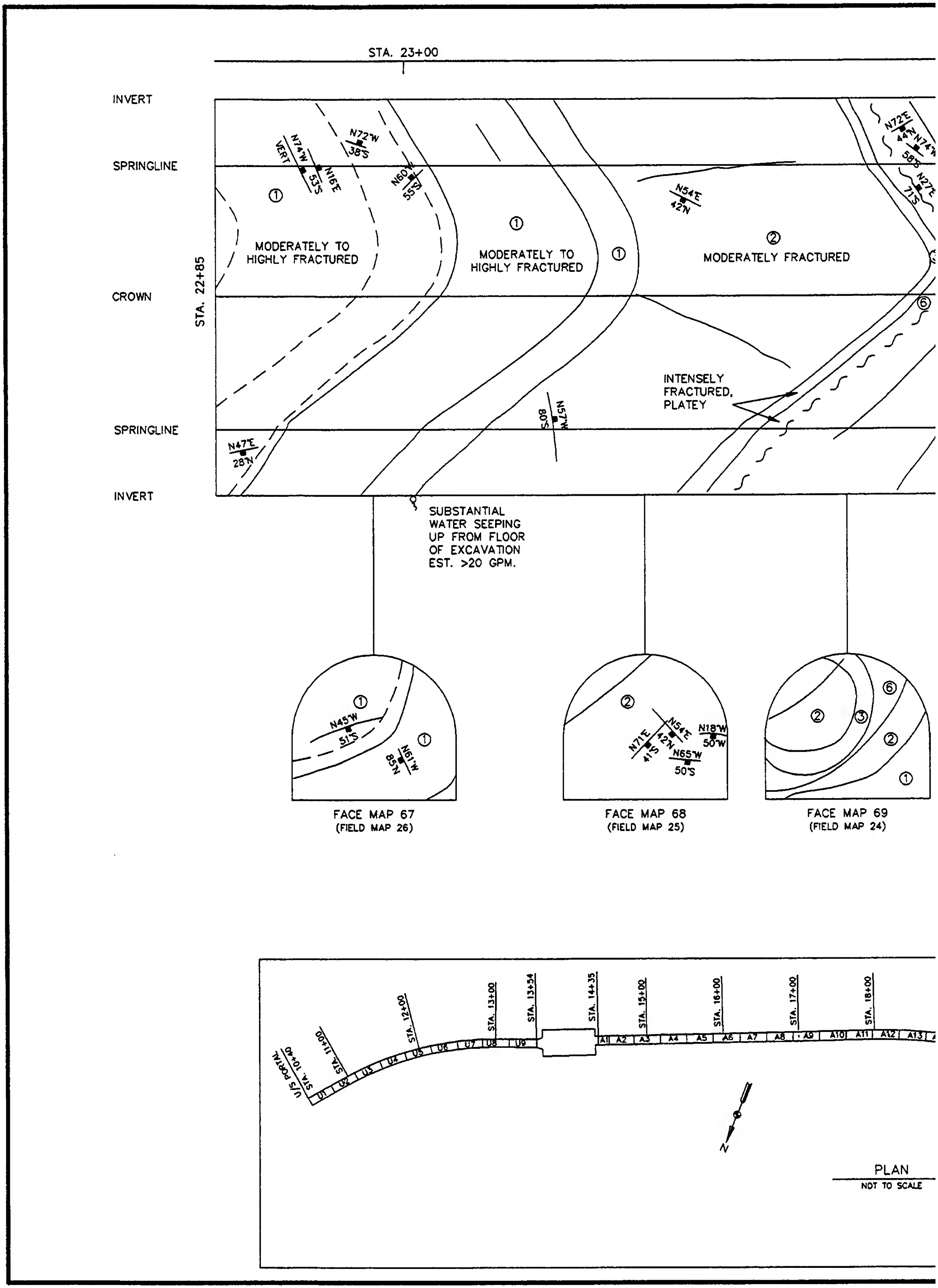
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 21+75 TO STA. 22+85

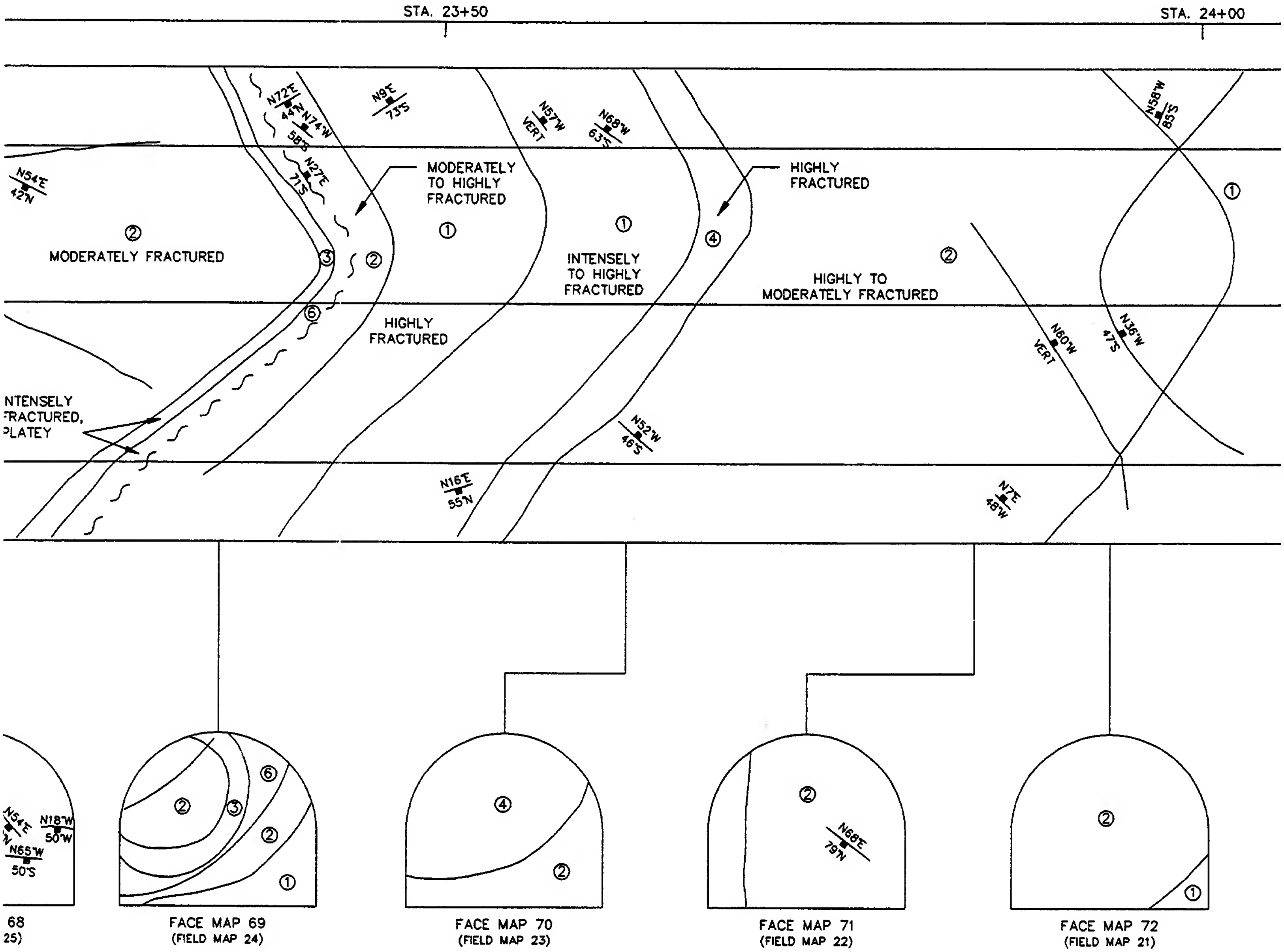
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CK. BY:	GEOL. BY:	FILE No.:
ERE		CEC	PLATE 40

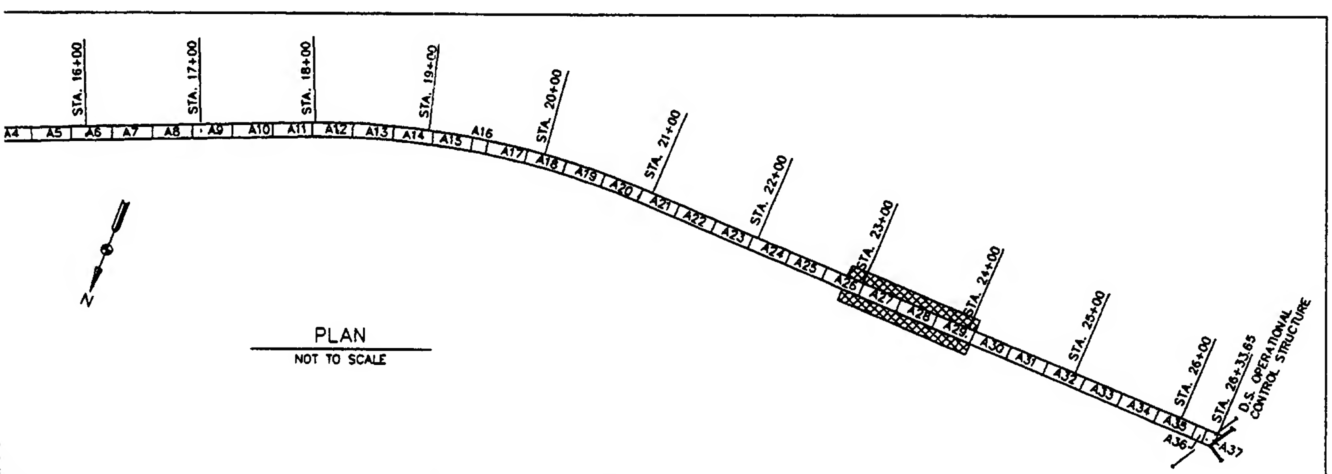


STA. 23+00
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 22+85
MODERATELY TO HIGHLY FRACTURED
MODERATELY TO HIGHLY FRACTURED
MODERATELY FRACTURED
INTENSELY FRACTURED, PLATEY
SUBSTANTIAL WATER SEEPING UP FROM FLOOR OF EXCAVATION EST. >20 GPM.
N72°W 38°S
N74°W 53°S
VERT
N16°E
N60°W 55°S
N54°E 42°N
N72°E 44°N
N74°W 58°S
N27°E 71°S
N57°W 80°S
N47°E 28°N
N45°W 51°S
N61°W 85°N
N54°E 42°N
N71°E 41°S
N18°W 50°W
N65°W 50°S
FACE MAP 67
(FIELD MAP 26)
FACE MAP 68
(FIELD MAP 25)
FACE MAP 69
(FIELD MAP 24)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1 U2 U3 U4 U5 U6 U7 U8 U9
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13
N
PLAN
NOT TO SCALE



NOTE:

SEE PLATE 11 FO
MAP LEGEND AND



PLAN
NOT TO SCALE

GI

0 5

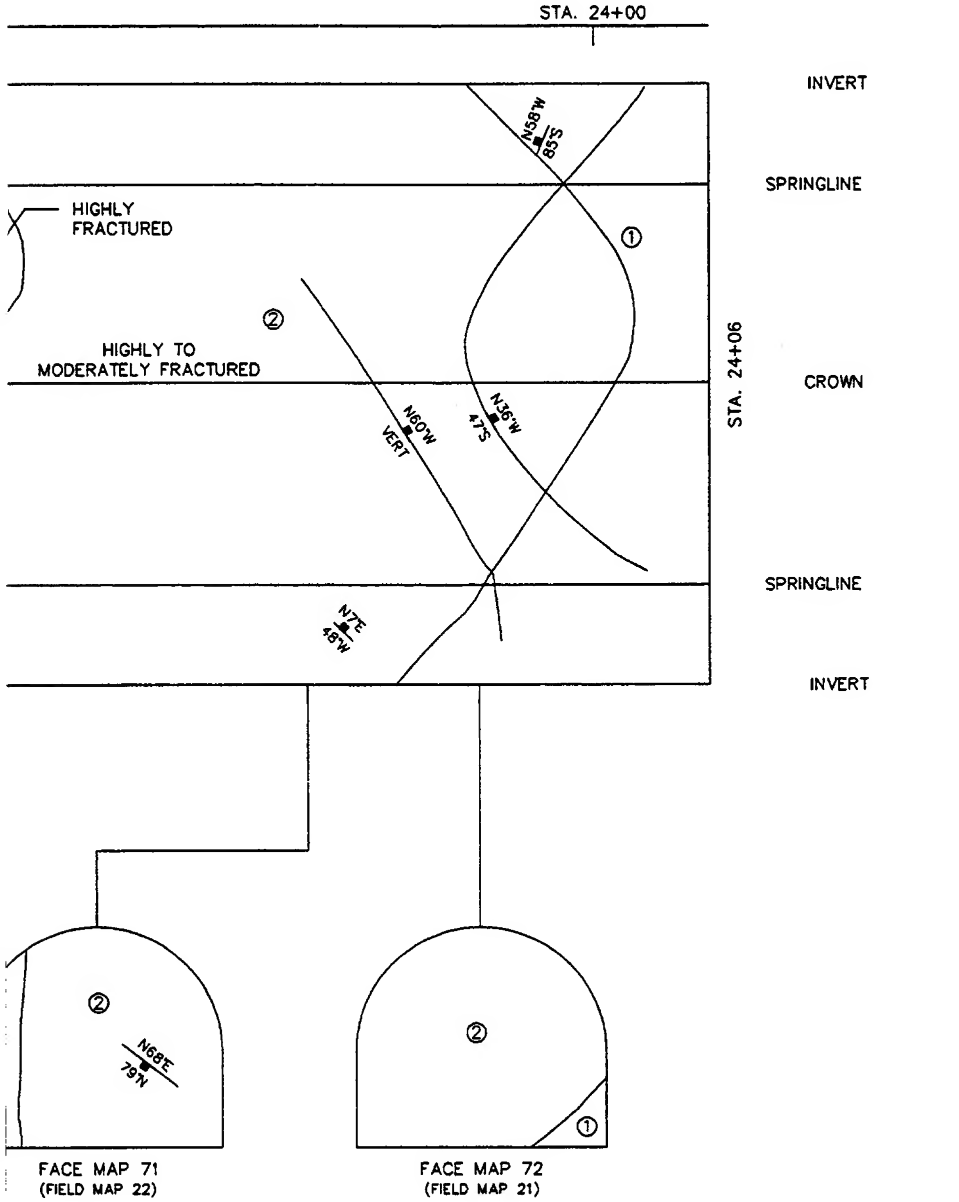
SALT

FLOO
GEOLOGIC MAP

DEP
SACRAMEN

SUBMITTED:
Robert L. [signature]
for CARL E. COLE
RESIDENT GEOLOGIST

ERE



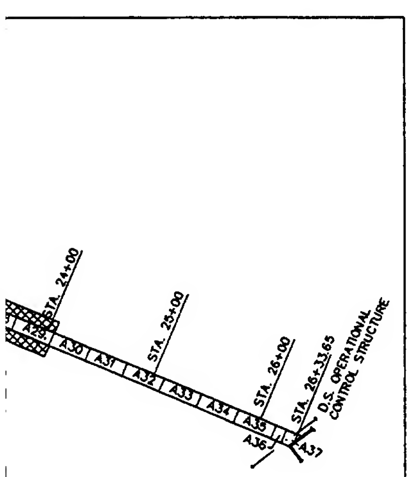
NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)



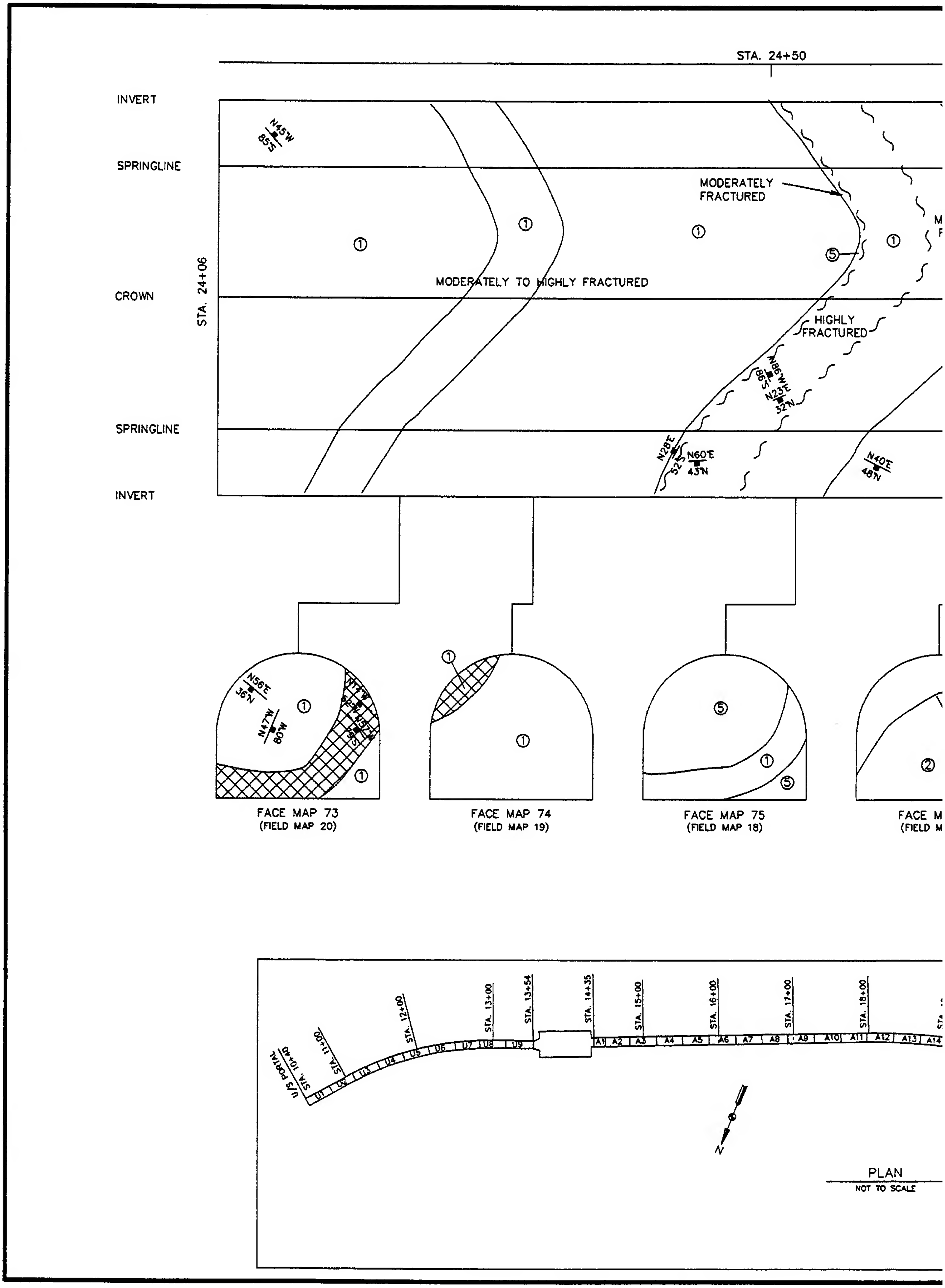
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS

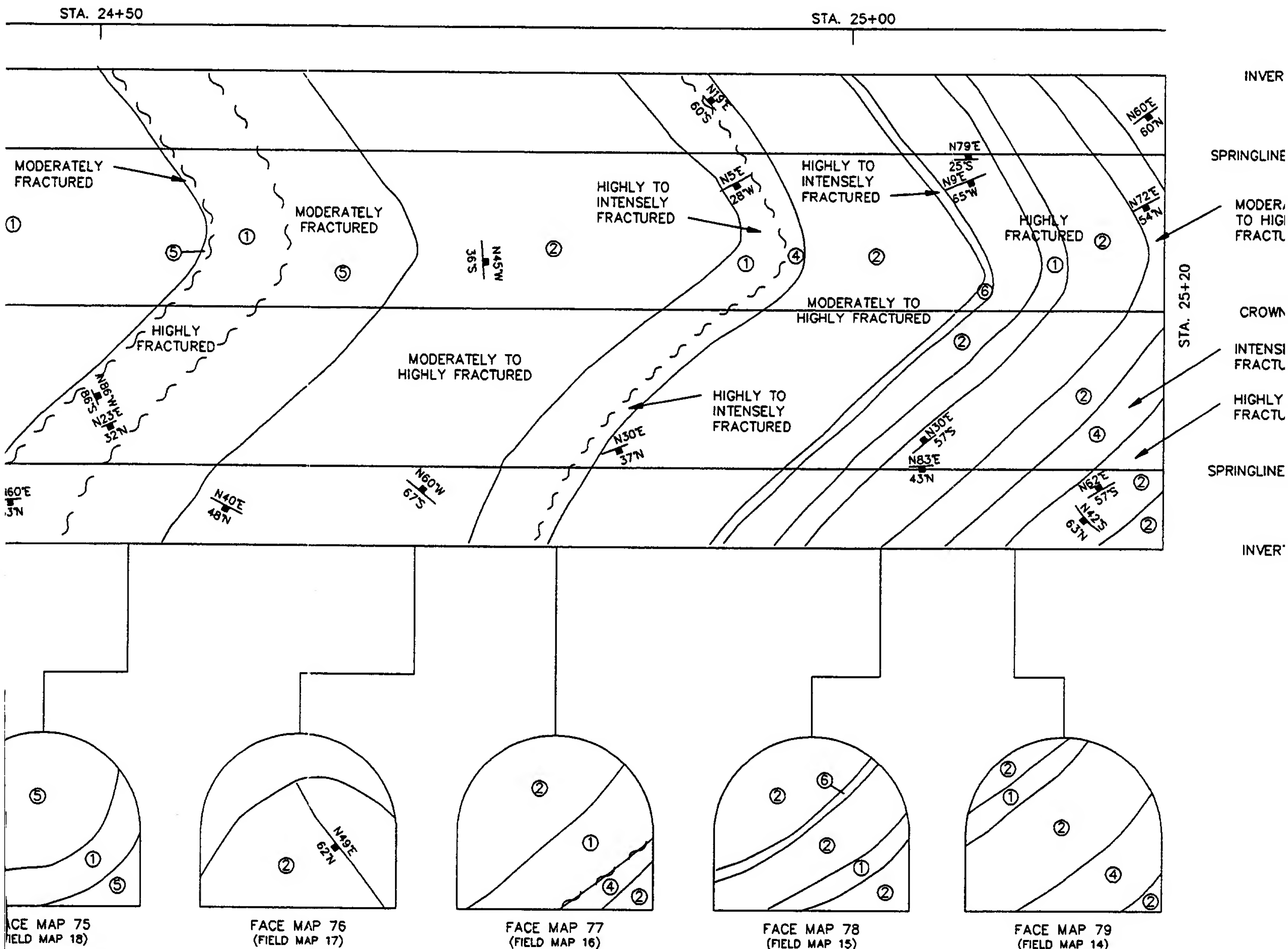
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 22+85 TO STA. 24+06

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. ... for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
ERE		CEC	PLATE 41



STA. 24+50
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 24+06
N45°W
85S
MODERATELY
FRACTURED
MODERATELY TO HIGHLY FRACTURED
HIGHLY
FRACTURED
N88°W
86S
N23°E
32°N
N28°E
52°S
N60°E
43°N
N40°E
48°N
N56°E
36°N
N47°W
80°W
FACE MAP 73
(FIELD MAP 20)
FACE MAP 74
(FIELD MAP 19)
FACE MAP 75
(FIELD MAP 18)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
N
PLAN
NOT TO SCALE



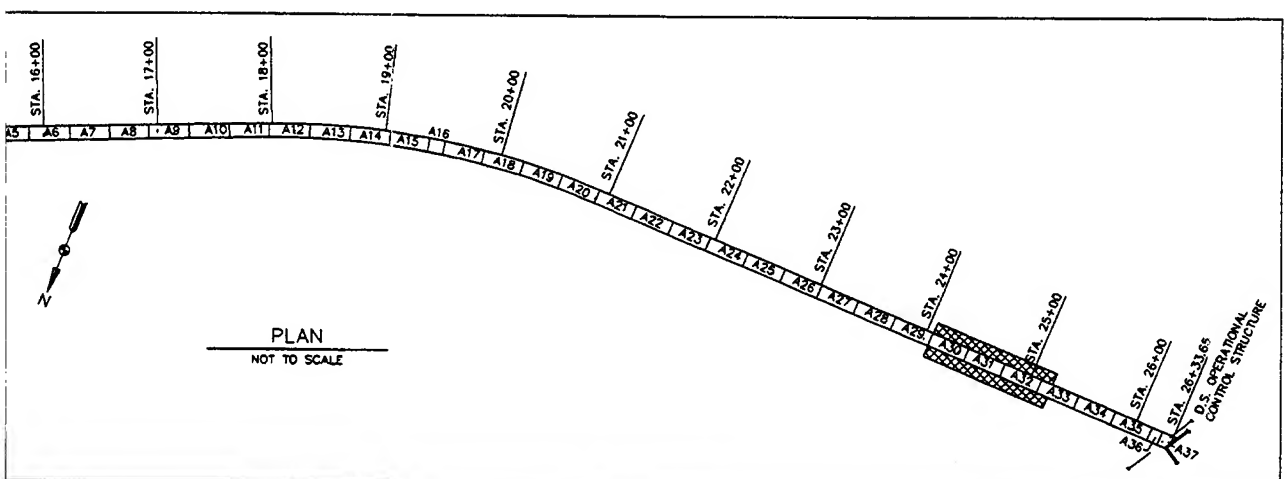
NOTE:

SEE PLATE 11 FOR GEC MAP LEGEND AND SYME

GRAPHIC

0 5 10

(SCALE I

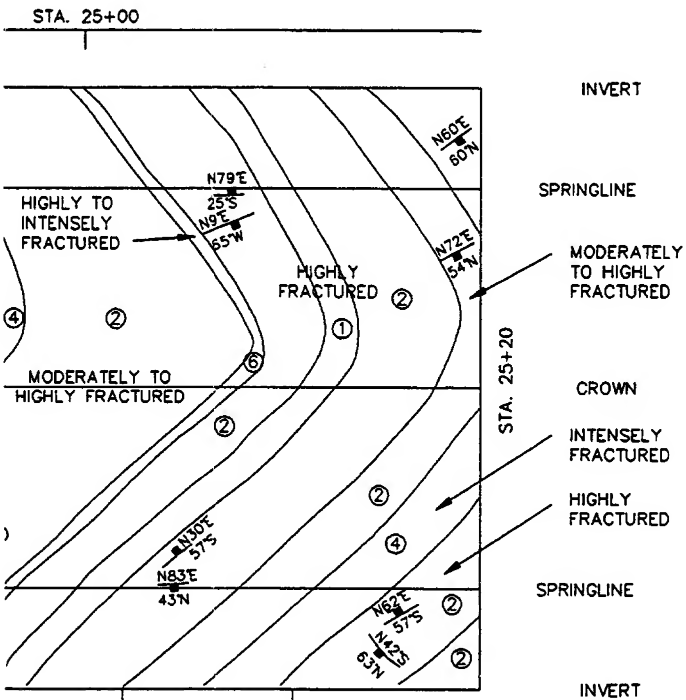


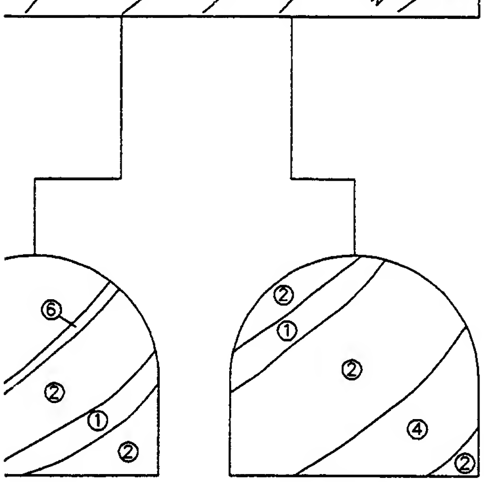
LITTLE
SALT LAKE C
OUTL
FLOOD CO
GEOLOGIC MAP STA.

DEPARTMEN
SACRAMENTO DISTR
SACRAME

SUBMITTED:
Robert L. Treat
for CARL E. COLE
RESIDENT GEOLOGIST

DR. BY:	CK. BY:	GEOL. BY:
ERE		CEC





E MAP 78
LD MAP 15)

FACE MAP 79
(FIELD MAP 14)

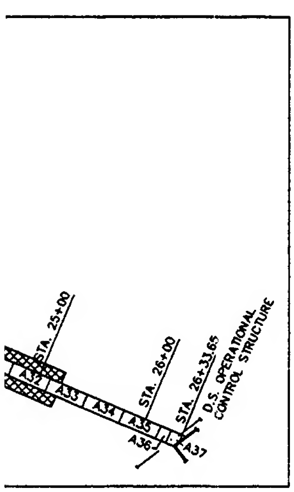
NOTE:

SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25

(SCALE IN FEET)



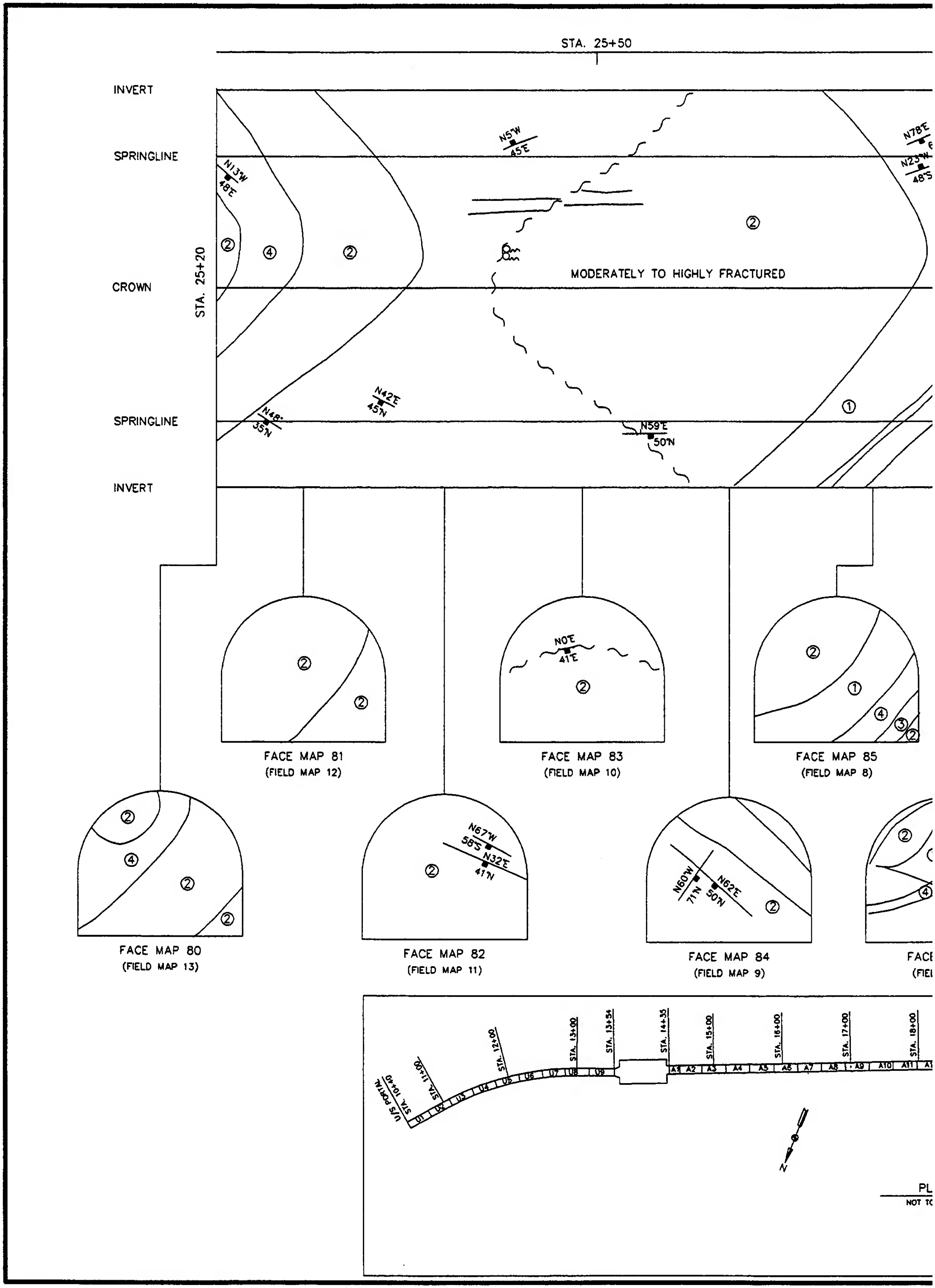
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 24+06 TO STA. 25+20

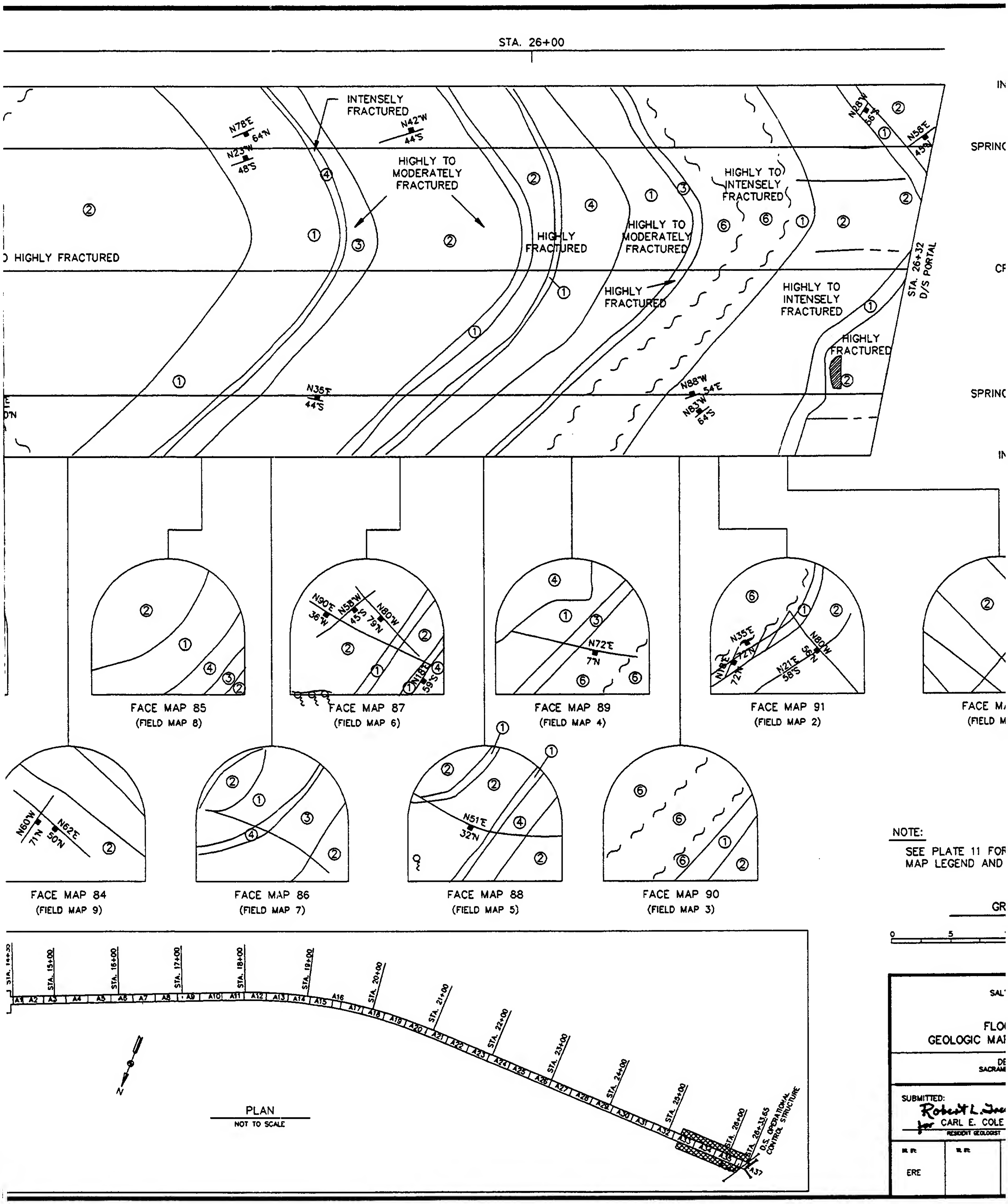
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

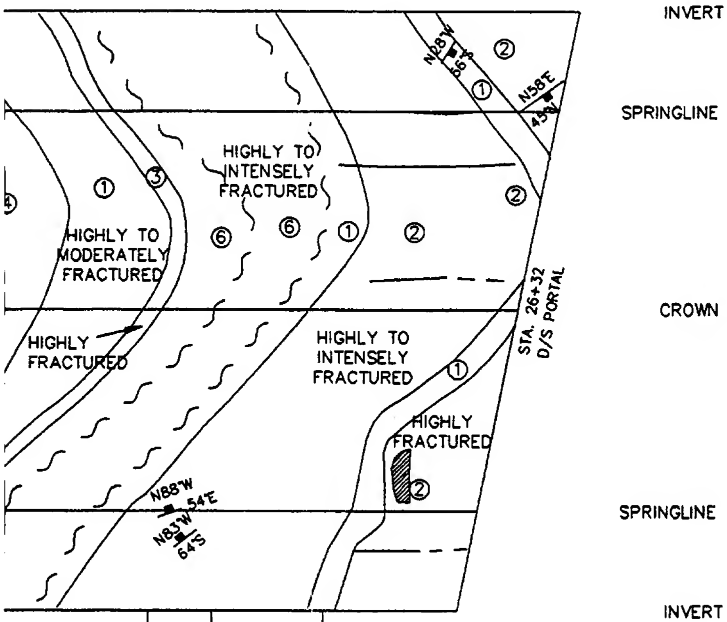
DR. BY:	TR. BY:	CKD. BY:	FILE No:
ERE		CEC	PLATE 42

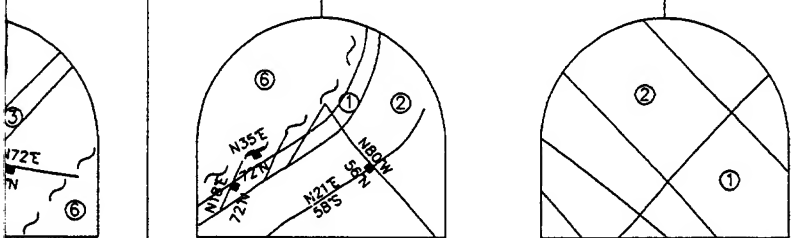


STA. 25+50
INVERT
SPRINGLINE
CROWN
SPRINGLINE
INVERT
STA. 25+20
N5°W
45°E
N13°W
48°E
N78°E
N23°W
48°S
MODERATELY TO HIGHLY FRACTURED
N42°E
45°N
N48°
35°N
N59°E
50°N
FACE MAP 81
(FIELD MAP 12)
N0°E
41°E
FACE MAP 83
(FIELD MAP 10)
FACE MAP 85
(FIELD MAP 8)
FACE MAP 80
(FIELD MAP 13)
N67°W
58°S
N32°E
41°N
FACE MAP 82
(FIELD MAP 11)
N60°W
71°N
N62°E
50°N
FACE MAP 84
(FIELD MAP 9)
U/S PORTAL
STA. 10+40
STA. 11+00
STA. 12+00
STA. 13+00
STA. 13+54
STA. 14+35
STA. 15+00
STA. 16+00
STA. 17+00
STA. 18+00
U1
U2
U3
U4
U5
U6
U7
U8
U9
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
N



STA. 26+00
INTENSELY FRACTURED
HIGHLY TO MODERATELY FRACTURED
HIGHLY FRACTURED
HIGHLY TO MODERATELY FRACTURED
HIGHLY TO INTENSELY FRACTURED
HIGHLY FRACTURED
HIGHLY TO INTENSELY FRACTURED
HIGHLY FRACTURED
STA. 26+32 D/S PORTAL
SPRING
SPRING
FACE MAP 85
(FIELD MAP 8)
FACE MAP 87
(FIELD MAP 6)
FACE MAP 89
(FIELD MAP 4)
FACE MAP 91
(FIELD MAP 2)
FACE MAP 84
(FIELD MAP 9)
FACE MAP 86
(FIELD MAP 7)
FACE MAP 88
(FIELD MAP 5)
FACE MAP 90
(FIELD MAP 3)
NOTE:
SEE PLATE 11 FOR
MAP LEGEND AND
PLAN
NOT TO SCALE
O.S. OPERATIONAL CONTROL STRUCTURE
STA. 26+33.65
FLO
GEOLOGIC MA
SUBMITTED:
CARL E. COLE
RESIDENT GEOLOGIST
ERE

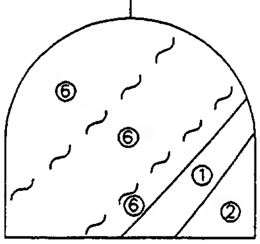




89
4)

FACE MAP 91
(FIELD MAP 2)

FACE MAP 92
(FIELD MAP 1)

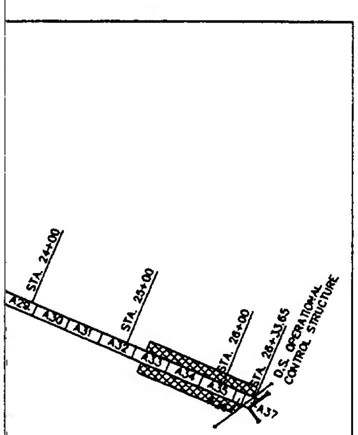


FACE MAP 90
(FIELD MAP 3)

NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP LEGEND AND SYMBOLS

GRAPHIC SCALE:

0 5 10 15 20 25
(SCALE IN FEET)



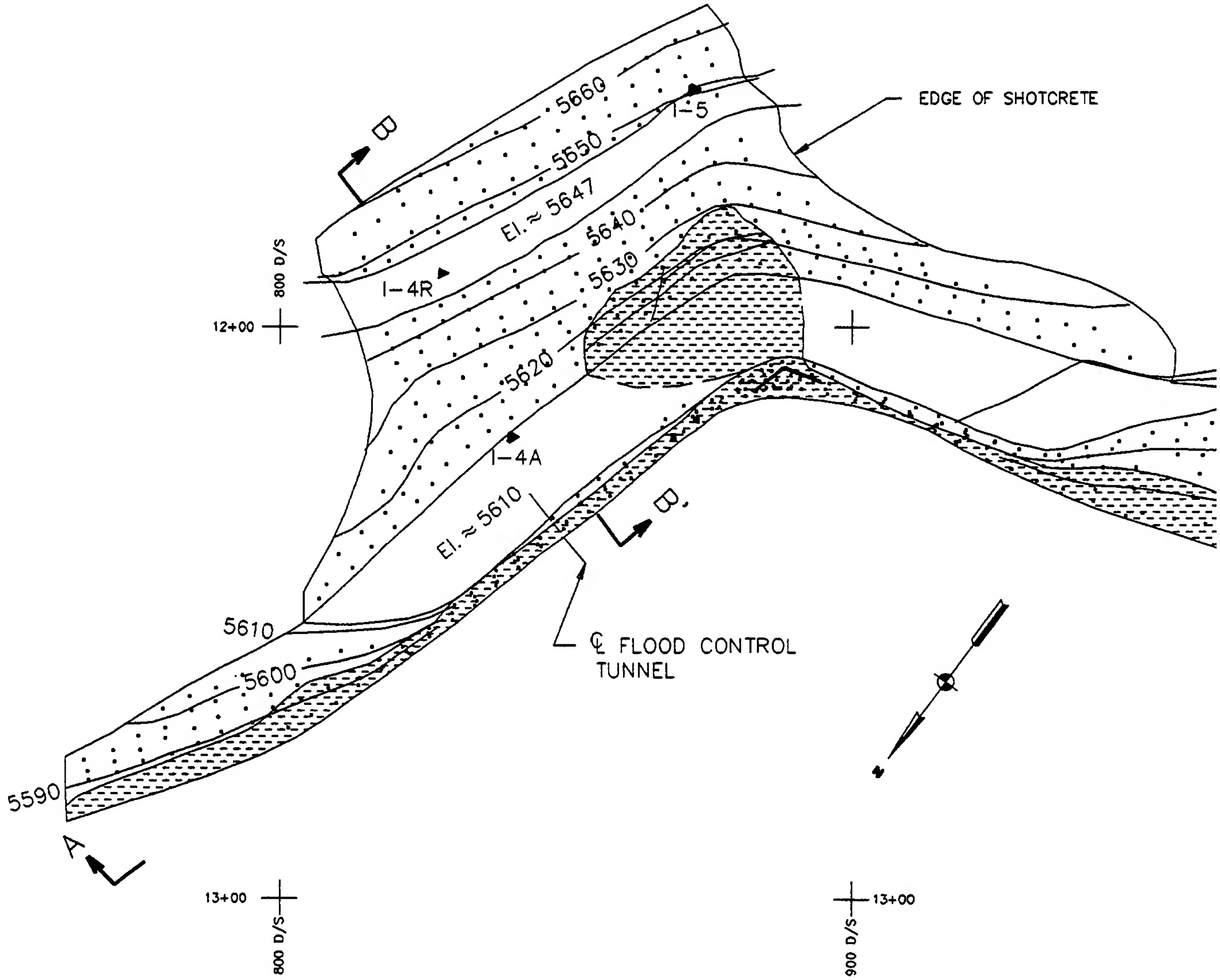
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
FLOOD CONTROL TUNNEL
GEOLOGIC MAP STA. 25+20 TO STA. 26+32

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

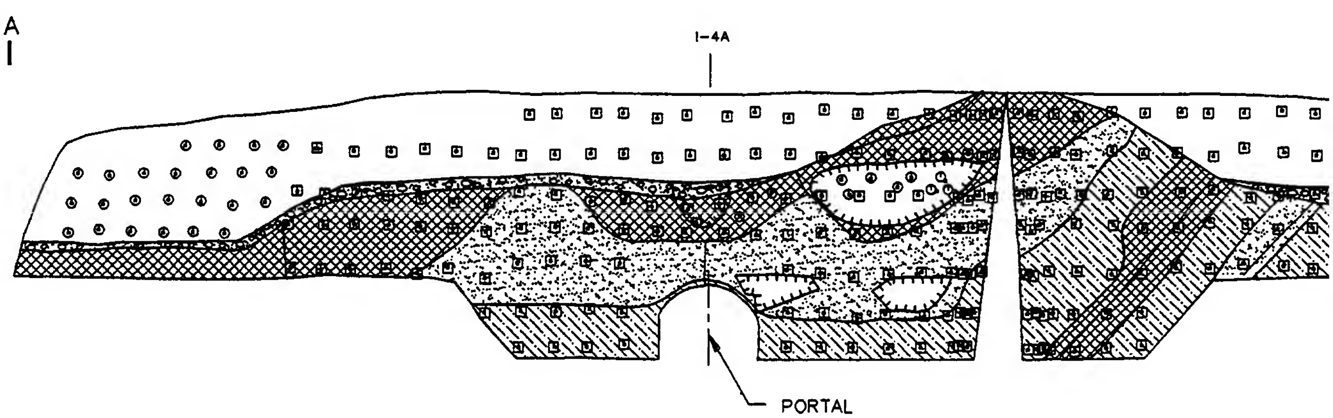
SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE		CEC	PLATE 43



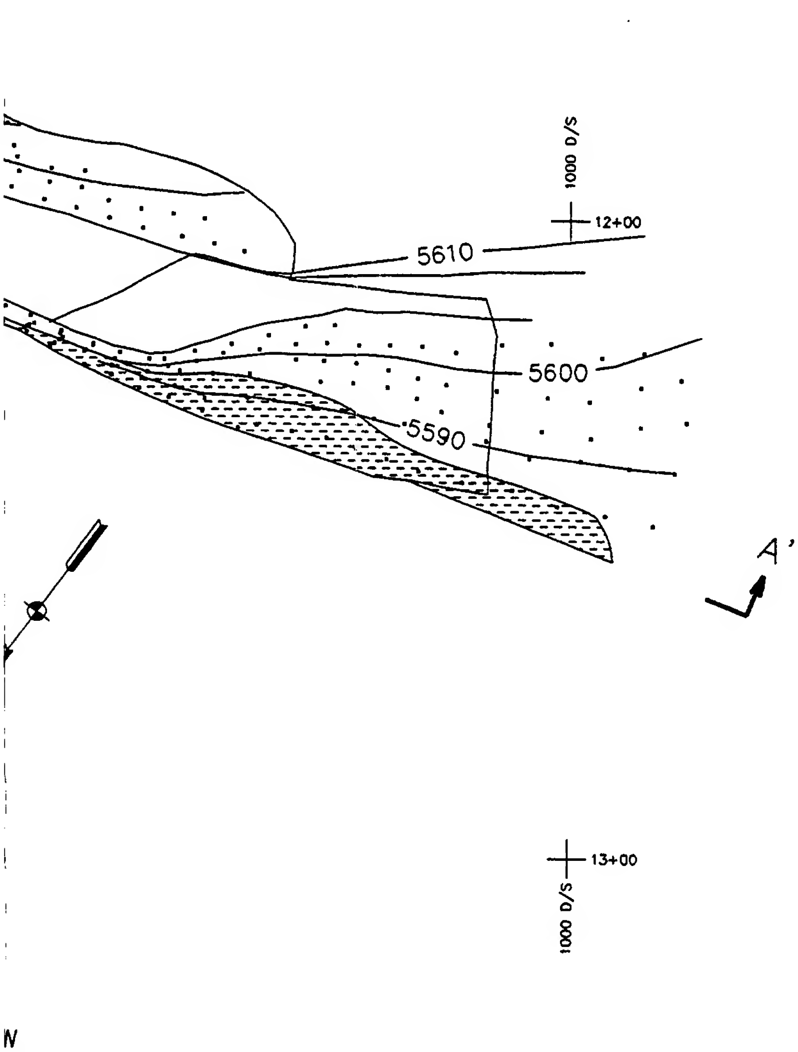
Note:
Coordinates are Embankment Construction Grid

PLAN VIEW

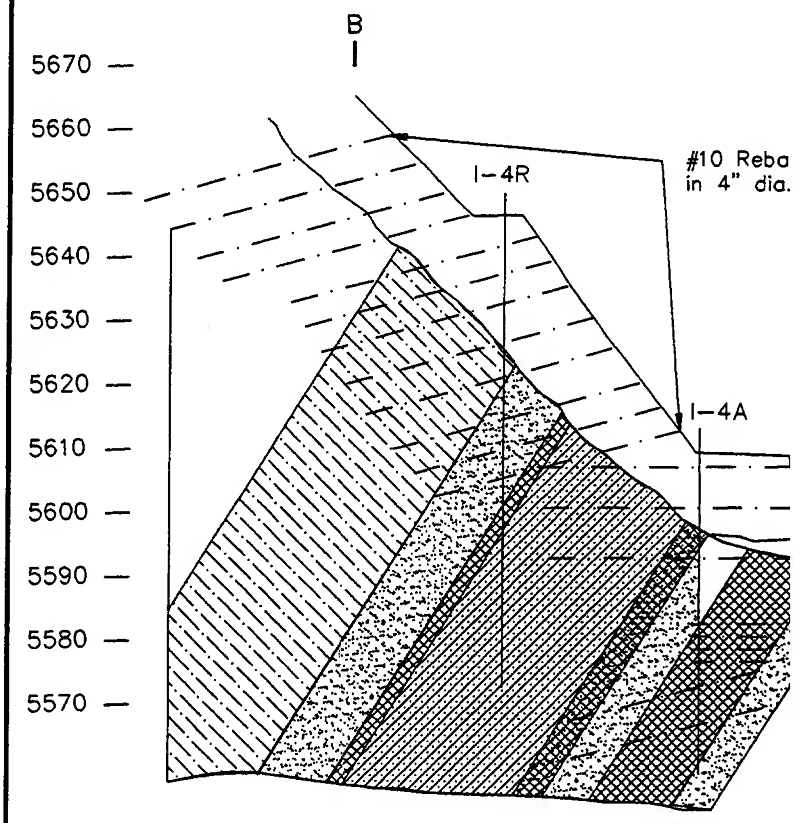


SECTION A – A' – ALONG VERTICAL SLOPE

C:\PROJECTS\LILDELL\W-FDNRPT\PL-44 03/10/95 10:33



W



SECTION B - B'

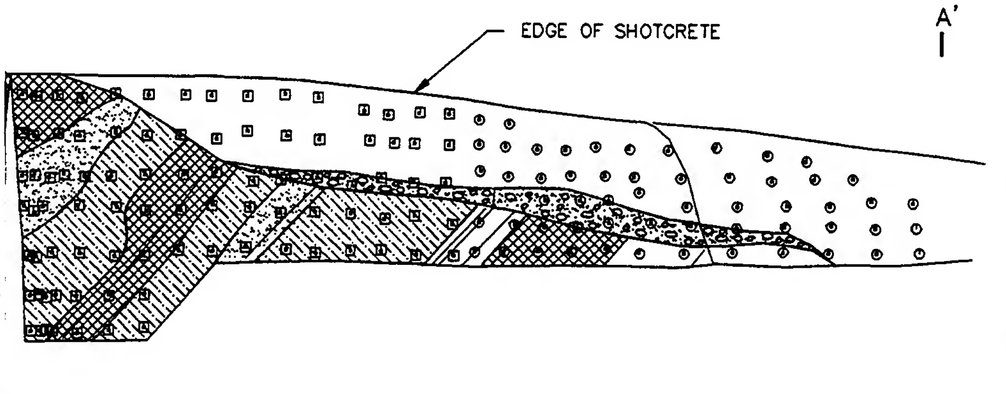
LEGEND

Slopewash	#10 Rebar in 8" dia.
Bedrock	
Older Alluvium	#10 Rebar in 4" dia.
Conglomerate	
Sandstone	I-4R ▲ Inclinomete
Siltstone	Rock Fall
Claystone/Soapstone	
5650 Contour line	

GRAPHIC SC

10' 0 10' 20' 30'

(SCALE IN FEET



VERTICAL SLOPE

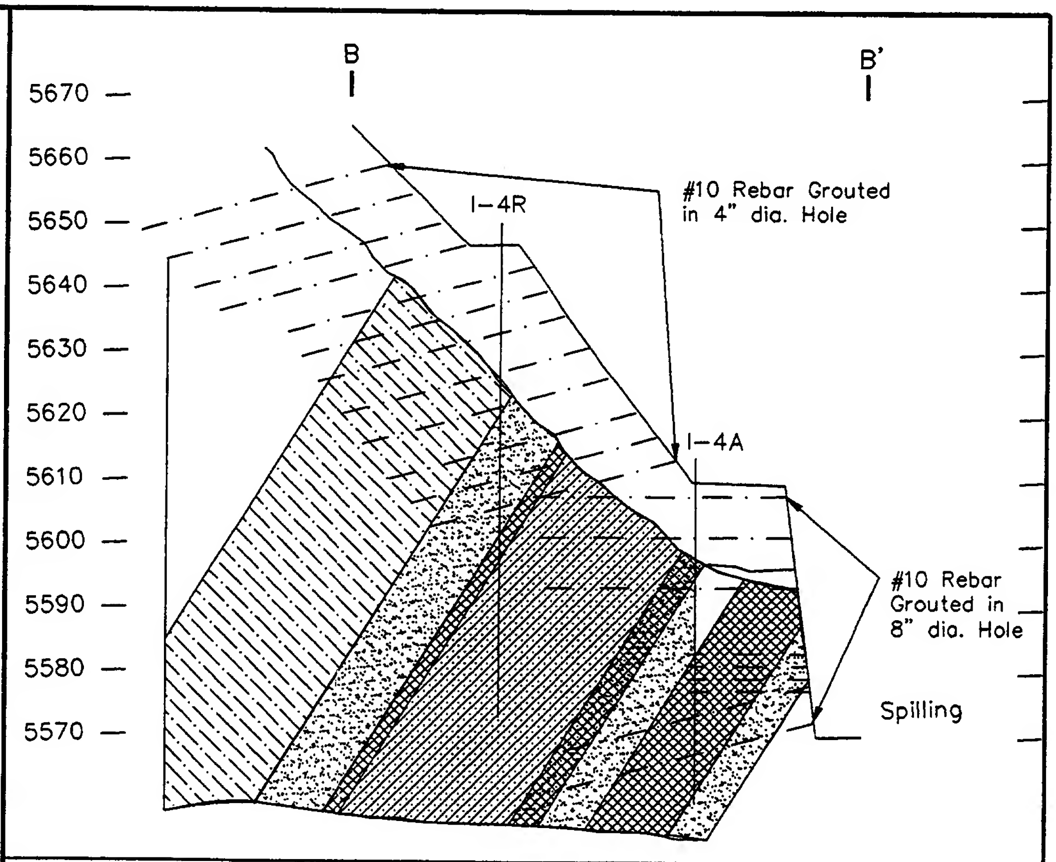
LITTLE DELL LAK
SALT LAKE CITY STREA

DOWNSTREAM P
GEOLOGIC MAP AND

DEPARTMENT OF THE
SACRAMENTO DISTRICT, CORPS
SACRAMENTO, CALIFO

SUBMITTED:
Robert L. Trout
for JOHN W. ROADIFER

DR. BY:	CHECKED BY:	CHECKED BY:	FILE No.:
JWR	JWR	MDR	

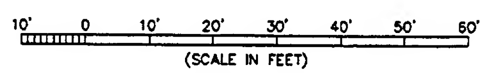


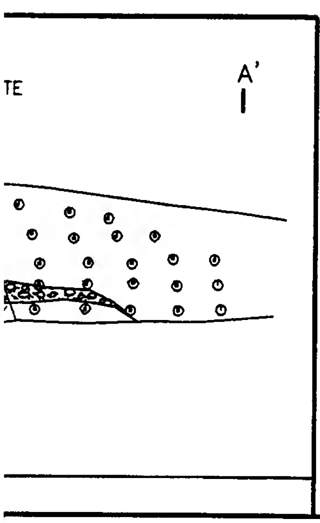
SECTION B - B'

LEGEND

- Slopewash
- Bedrock
- Older Alluvium
- Conglomerate
- Sandstone
- Siltstone
- Claystone/Soapstone
- 5650 Contour line
- #10 Rebar Grouted in 8" dia. Hole
- #10 Rebar Grouted in 4" dia. Hole
- I-4R ▲ Inclinometer
- Rock Fall

GRAPHIC SCALE:



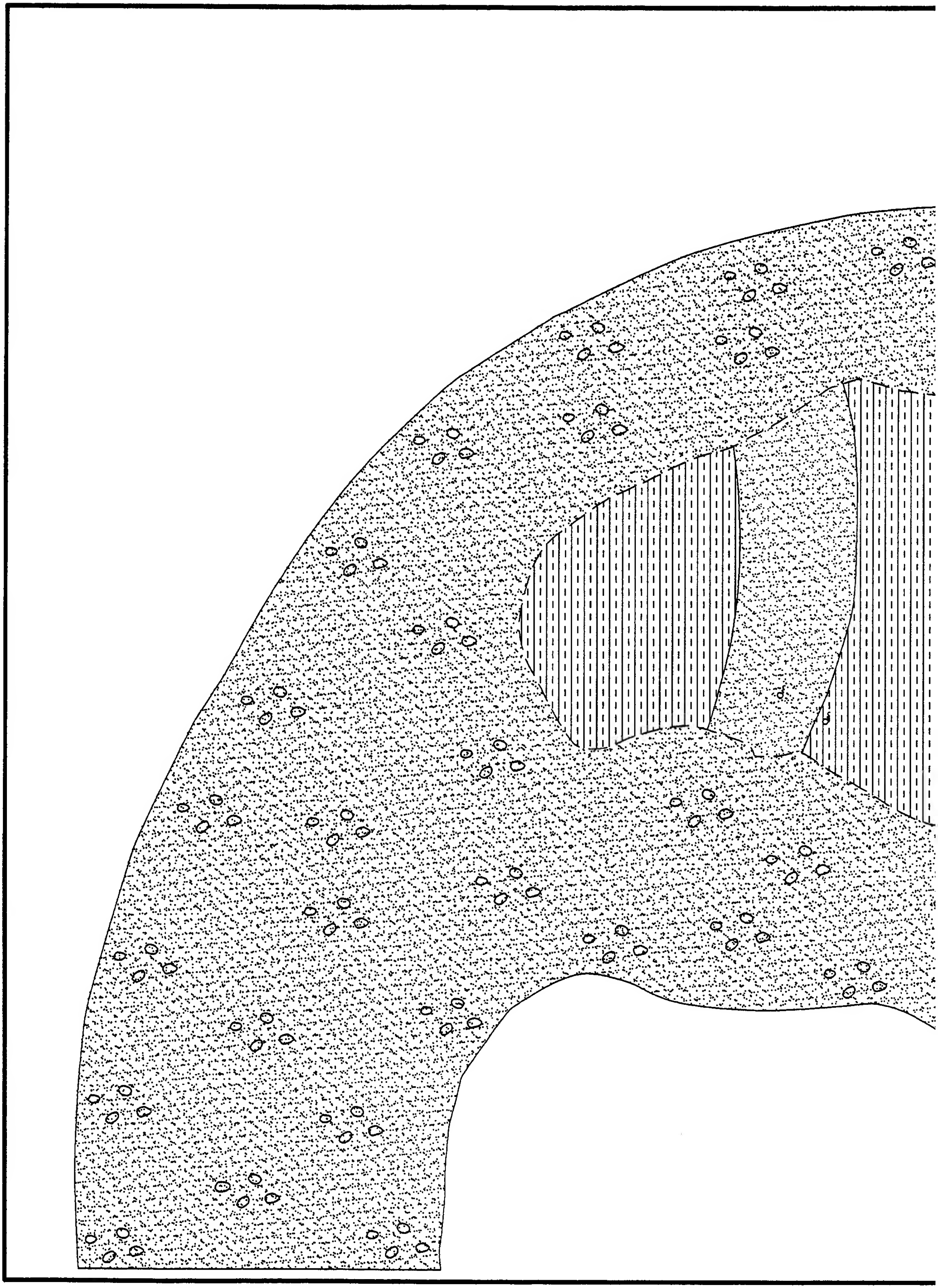


LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

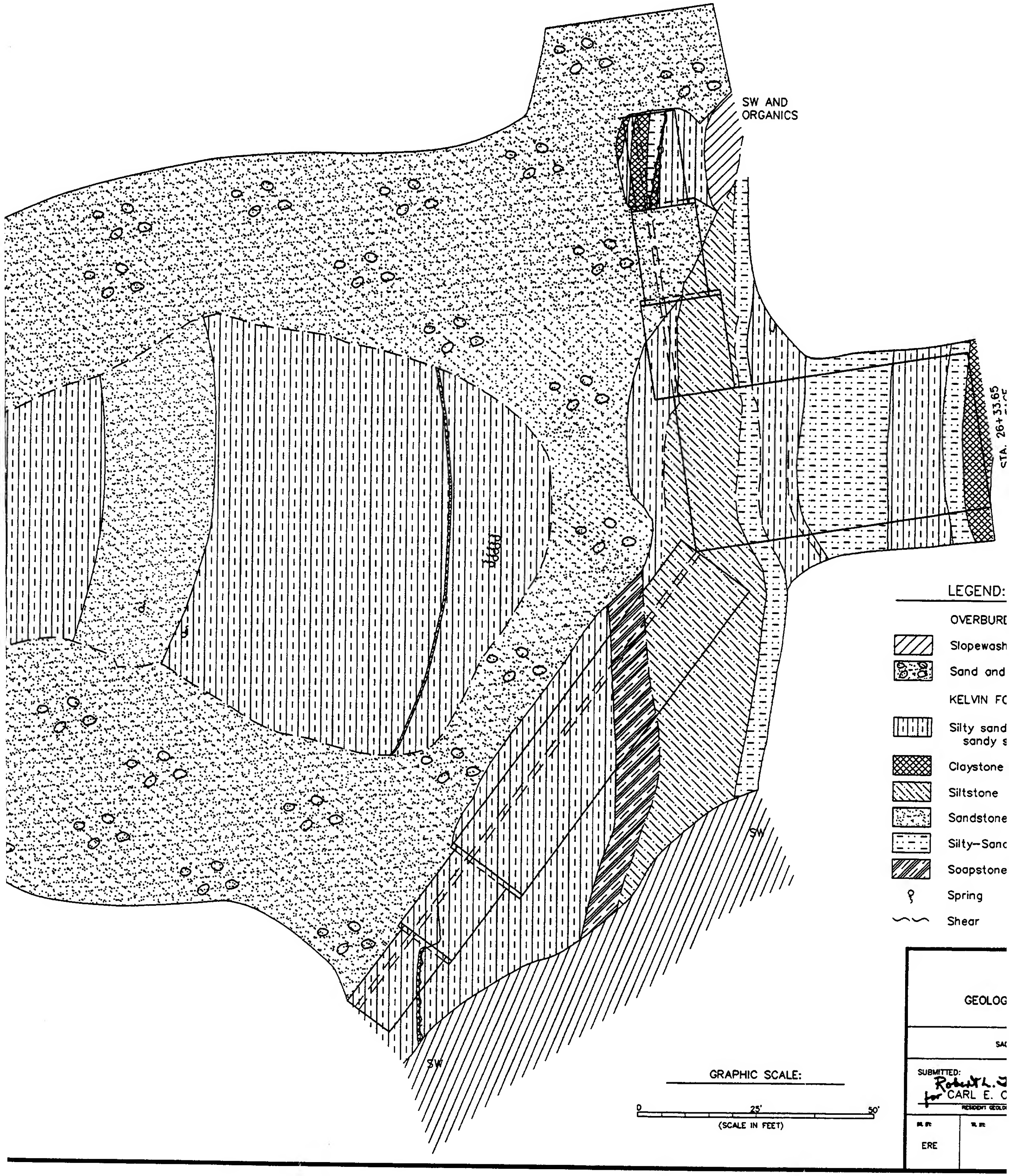
DOWNSTREAM PORTAL
GEOLOGIC MAP AND SECTIONS

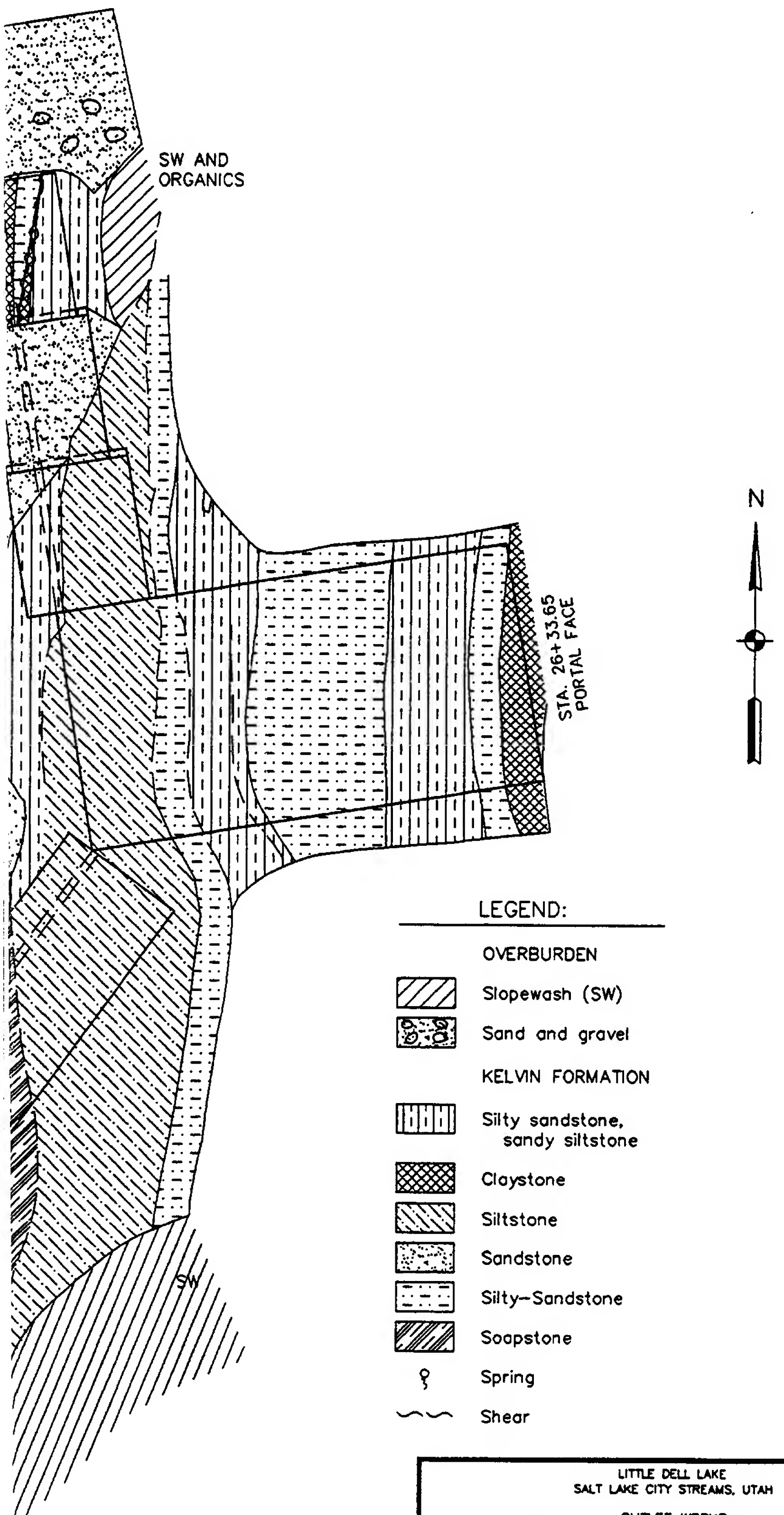
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for JOHN W. ROADIFER			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: JWR	CHECKED BY: JWR	CHECKED BY: MDR	FILE No.: PLATE 44



C:\PROJECTS\LILDELL\W-FDNRPT\PL-45 03/10/95 10:37


SW AND ORGANICS
STA. 26+33.65
SW
SW
LEGEND:
OVERBURD
Slopewash
Sand and
KELVIN FO
Silty sand
sandy s
Claystone
Siltstone
Sandstone
Silty–Sand
Soapstone
Spring
Shear
GEOLOG
SUBMITTED:
CARL E. C
ERE
GRAPHIC SCALE:
0
25'
50'
(SCALE IN FEET)



GRAPHIC SCALE:

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

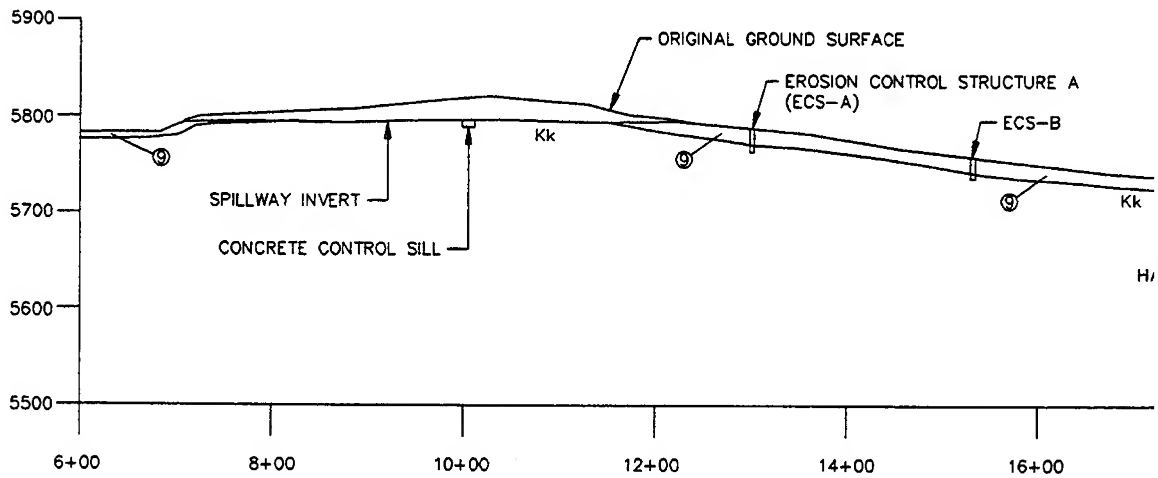
OUTLET WORKS

GEOLOGIC MAP OF DOCS, WINGWALLS, AND PLUNGE POOL

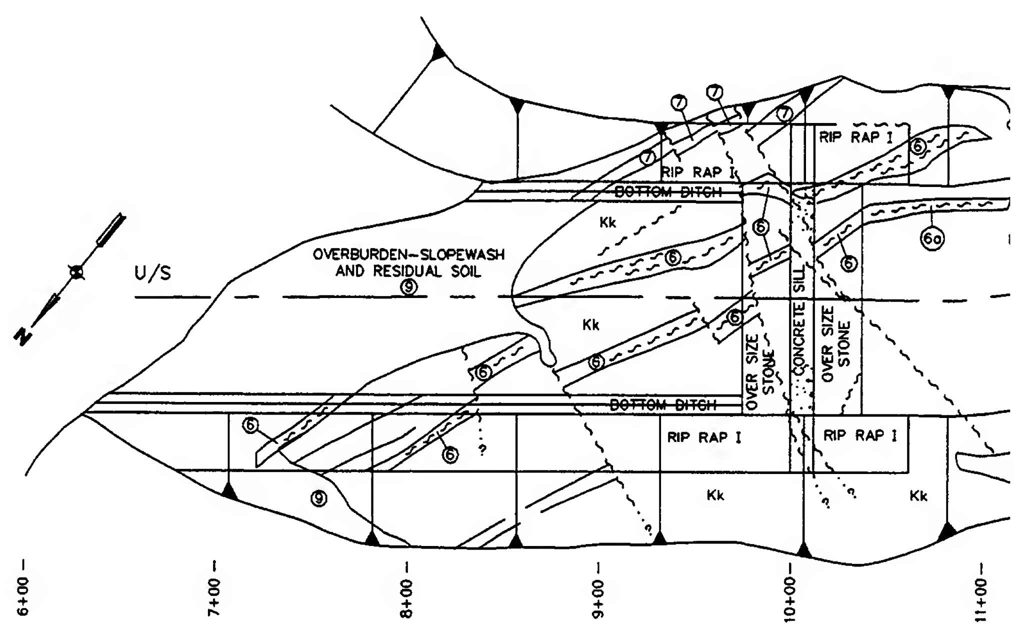
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE		CEC	PLATE 45

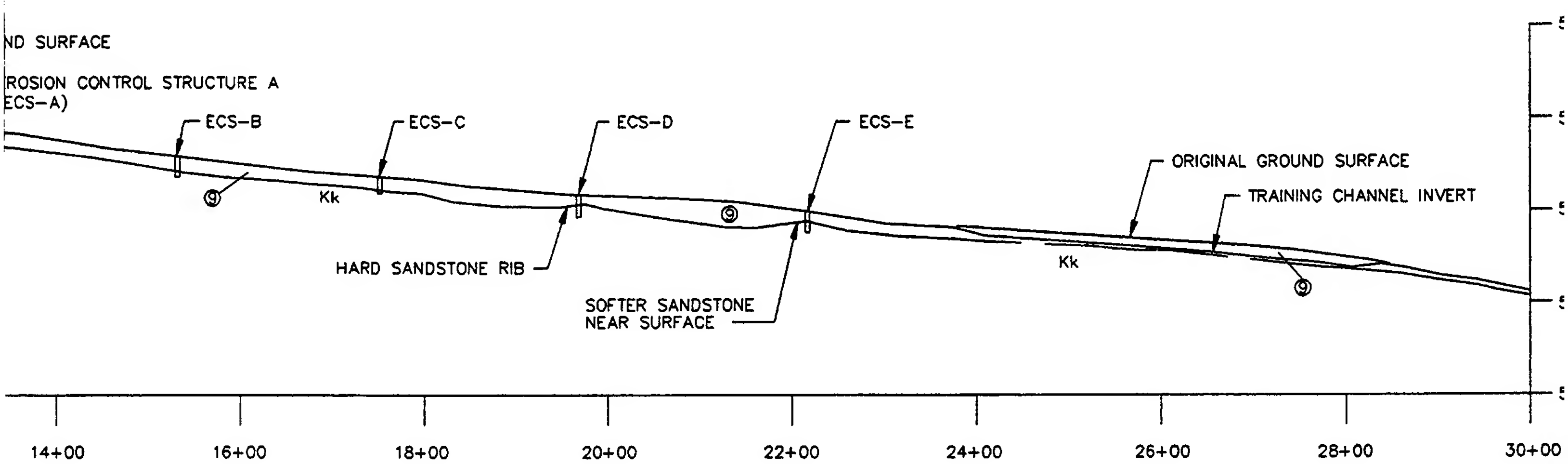


SPILLWAY PROFILE



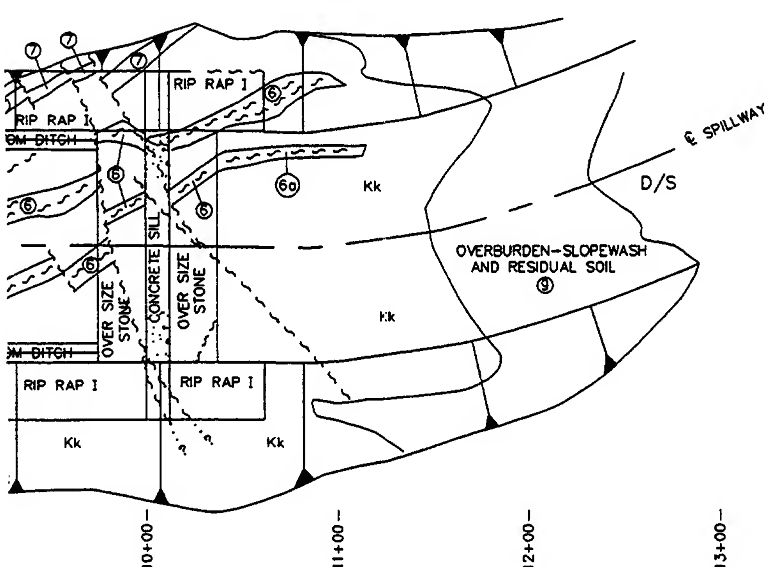
NOTE:
Kk IS UNDIFFERENTIATED KELVIN FORMATION

SPILLWAY EXCAVATION



SPILLWAY PROFILE

NOTE:
SEE PLATE 11 FOR GEC
MAP SYMBOLS AND LEG



SPILLWAY EXCAVATION

GRAPHIC SCAL

0 200' (SCALE IN FEET

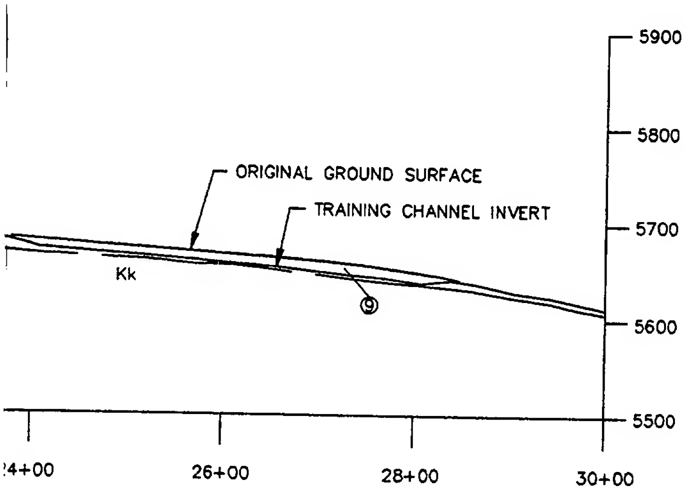
0 100' (SCALE IN FEE

LITTLE
SALT LAKE CI
SP
GEOL
PROFILE, EXC

DEPARTMEN
SACRAMENTO DISTR
SACRAME

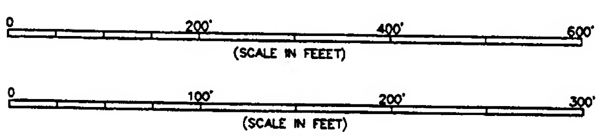
SUBMITTED:
Robert L. Trest
for CARL E. COLE
RESIDENT GEOLOGIST

ERE | | BAB



NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP SYMBOLS AND LEGEND.

GRAPHIC SCALES:



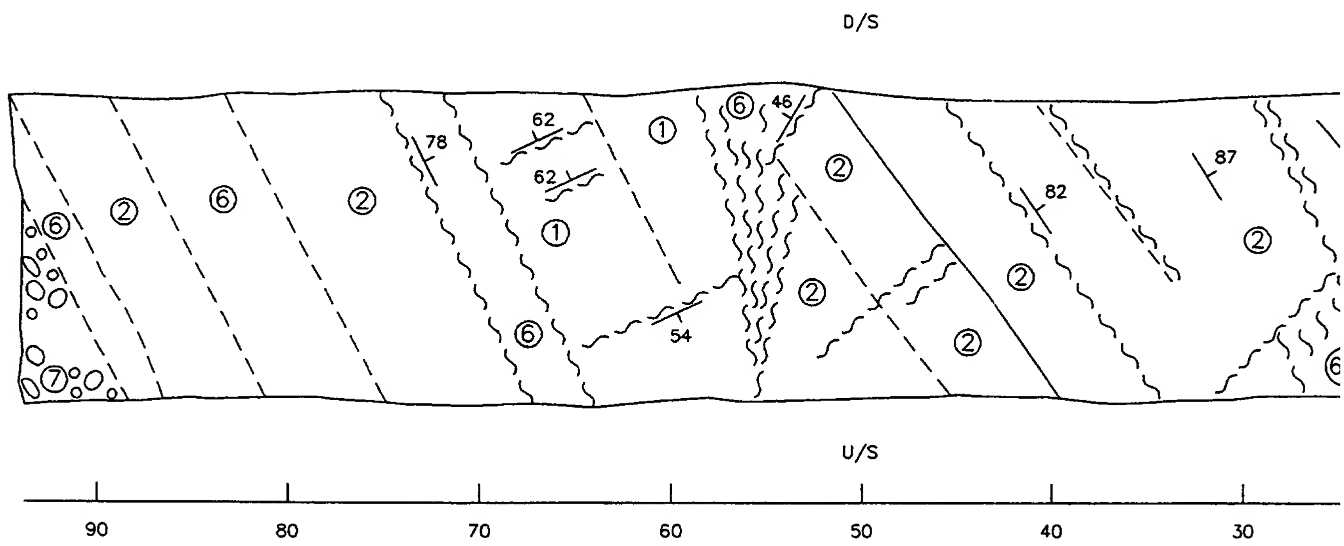
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

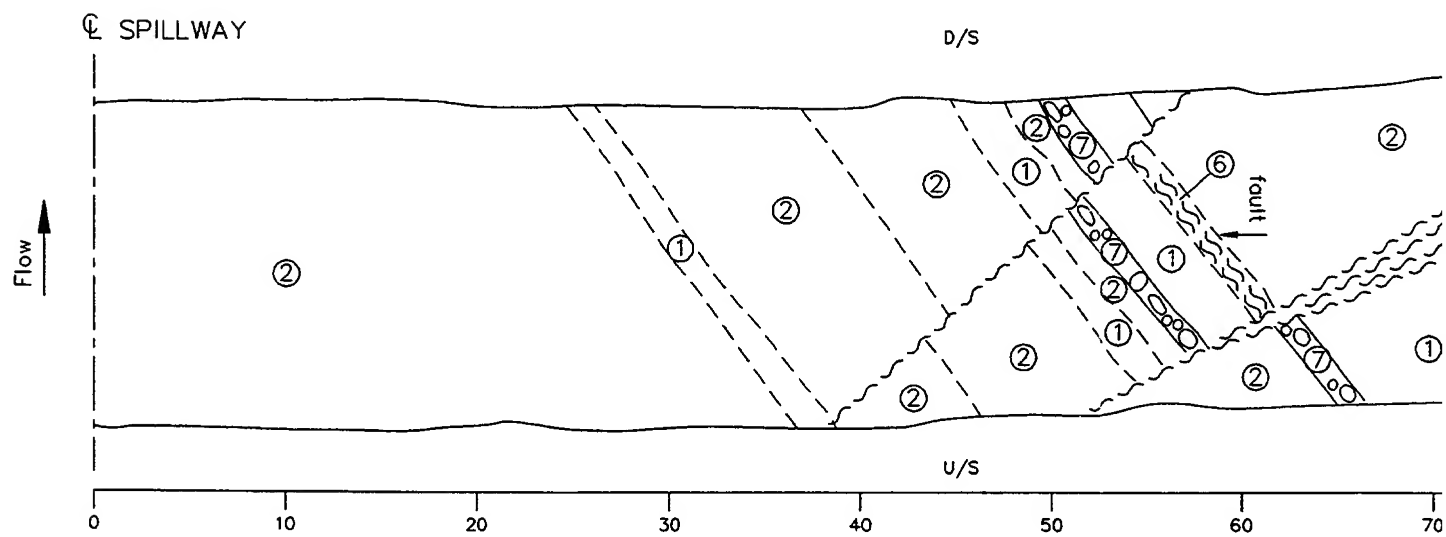
SPILLWAY
GEOLOGIC MAP
PROFILE, EXCAVATION AND SILL

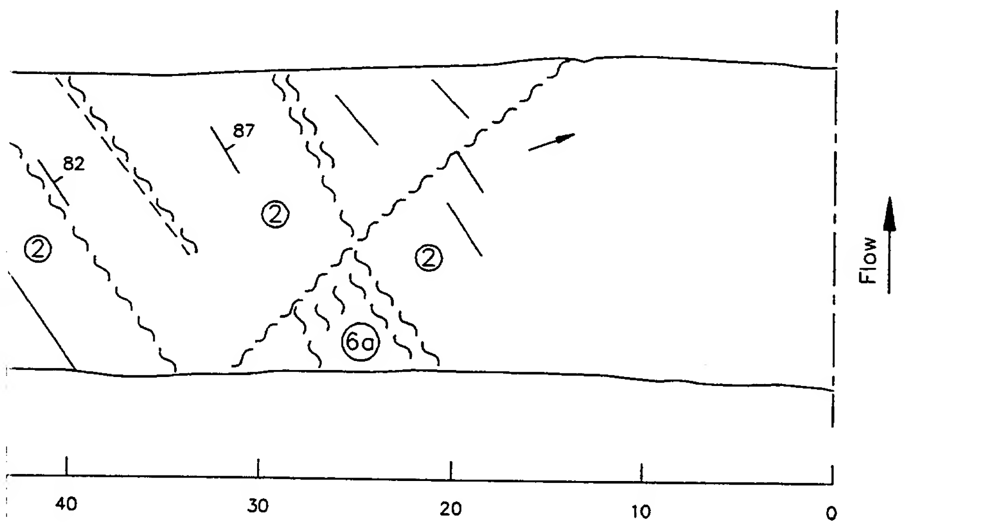
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

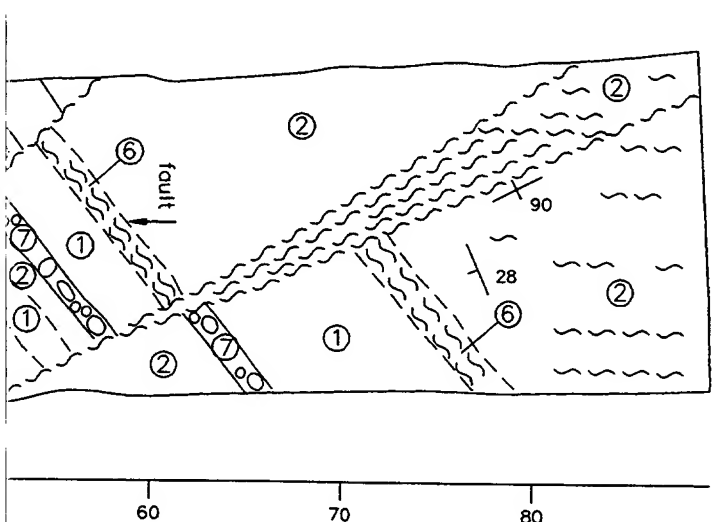
SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

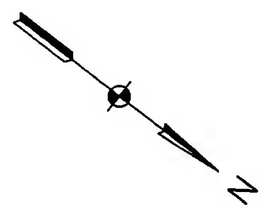
ERE		BAB	PLATE 46


D/S
62
78
62
46
87
82
54
U/S
90
80
70
60
50
40
30


℄ SPILLWAY
D/S
Flow
fault
U/S
0
10
20
30
40
50
60
70







NOTE:
SEE PLATE 11 FOR GEOLOGIC MAP SYMBOLS AND LEGEND.

GRAPHIC SCALE:

0 10' 20' 30'
(SCALE IN FEET)

LEGEND:

CONTACT BETWEEN BEDS
SHEAR OR FAULT

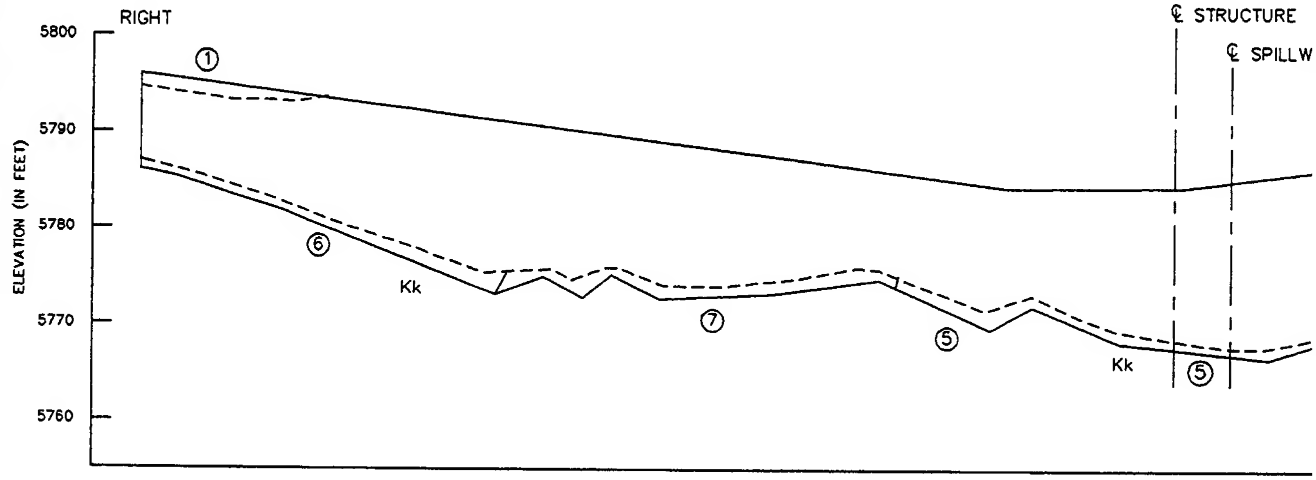
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

SPILLWAY

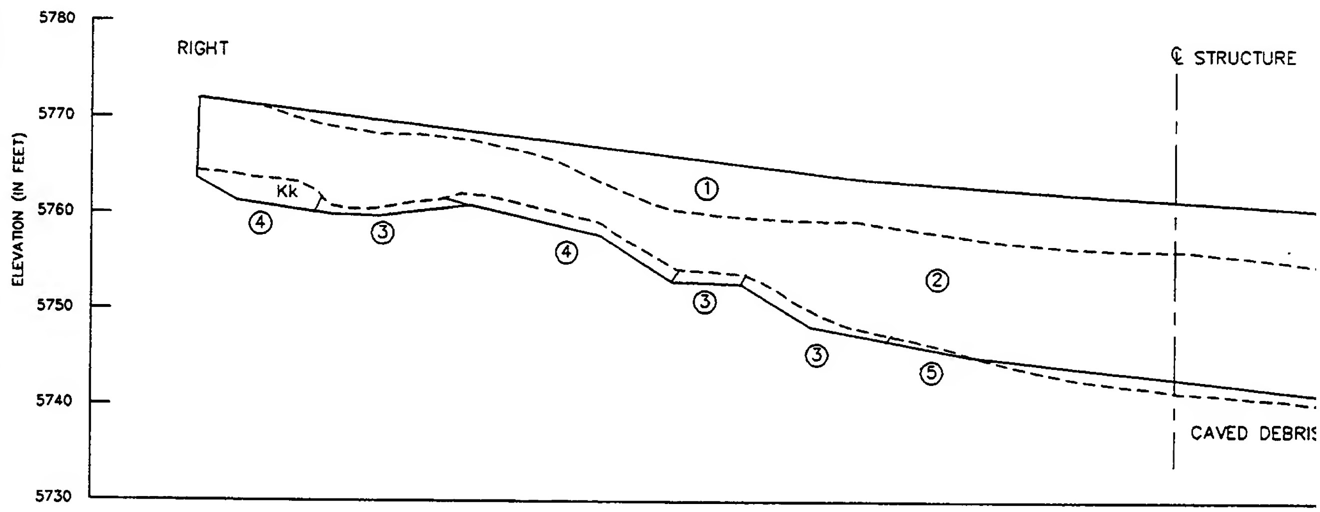
GEOLOGIC MAP OF CONTROL SILL

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

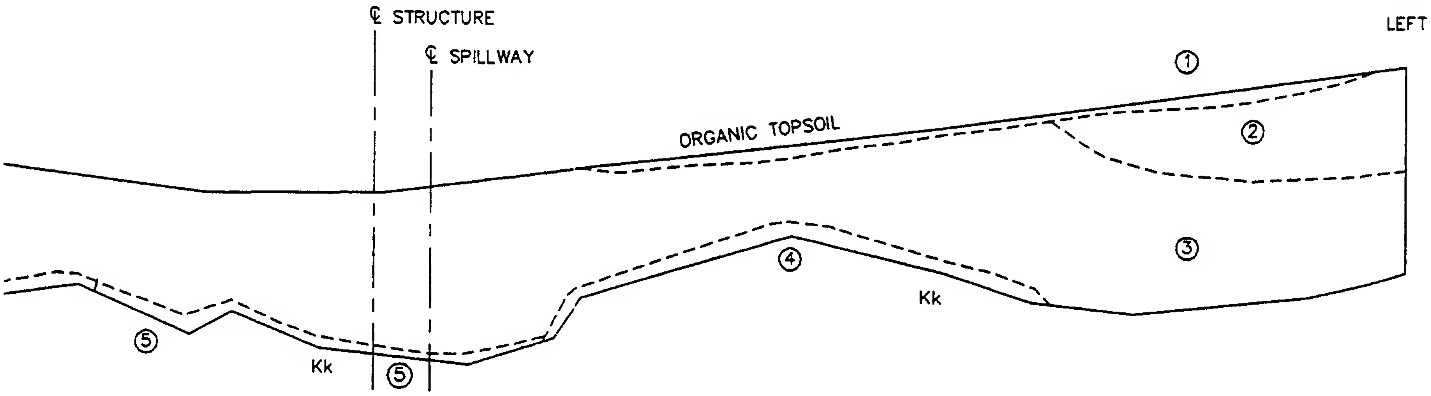
SUBMITTED: for CARL E. COLE RESIDENT GEOLOGIST		APPROVED: PAUL M. PARSONEAULT RESIDENT ENGINEER	
ERE		BAB	PLATE 47



EROSION CONTROL STRUCTU
STATION 12+99.22
(LOOKING UPSTREAM)



EROSION CONTROL STRUCTU
STATION 15+24.77
(LOOKING UPSTREAM)



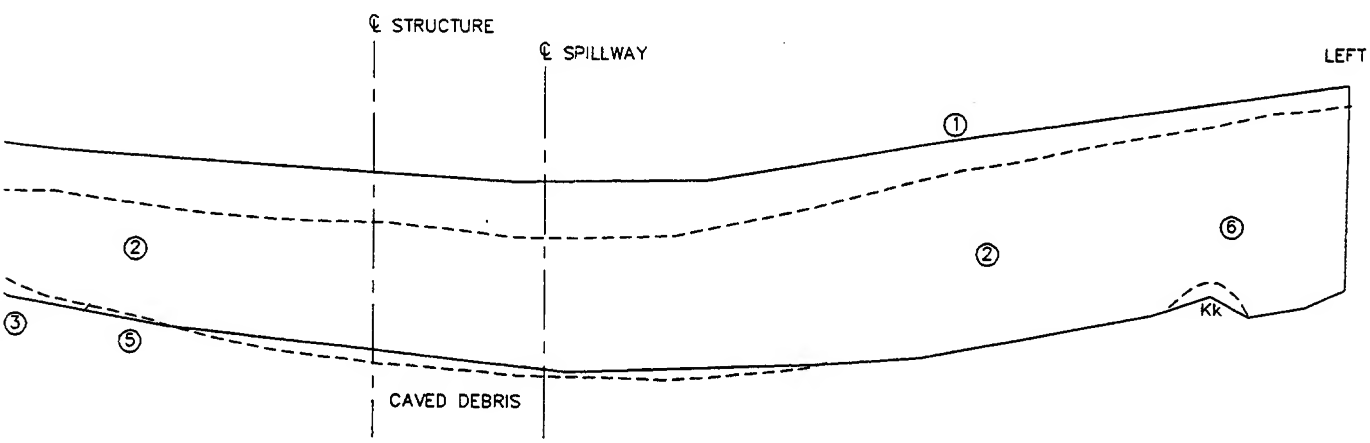
EROSION CONTROL STRUCTURE "A"
STATION 12+99.22
(LOOKING UPSTREAM)

LEGEND:

1. ORGANIC T
2. SLOPEWASI
except cor
fragments;
broken; us
3. SLOPEWASI

KELVIN FORM

4. SANDSTONI
grained ha
5. SILTSTONE
greenish gi
iron oxide
6. CLAYSTONE
in fracture
7. SILTSTONE
hard. Iron



EROSION CONTROL STRUCTURE "B"
STATION 15+24.77
(LOOKING UPSTREAM)

LEGEND:

1. ORGANIC T
2. SLOPEWASH

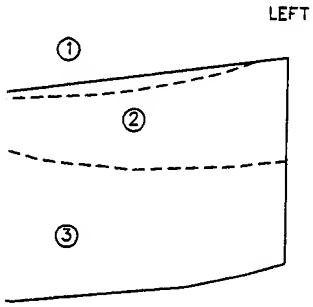
KELVIN FORM/

3. SILTSTONE
moderately
oxide stain
4. SANDSTONE
fine graine
contain cal
10R 4/6, s
5. CLAYSTONE
in fracture
Fracturing

0

SUBMIT

GEB

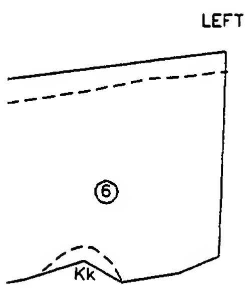


LEGEND:

1. ORGANIC TOPSOIL
2. SLOPEWASH (SW) – Same as reddish brown clay (below) except contains about 40% gravel and cobble sized fragments; fragments are rounded but in many cases broken; usually quartzite.
3. SLOPEWASH (SW) – Reddish brown clay

KELVIN FORMATION (Kk)

4. SANDSTONE, yellowish gray 5Y 8/1 medium to fine grained hard; some iron oxide staining on fractures.
5. SILTSTONE – moderate reddish brown 10R 4/6 to light greenish gray 5GY 8/1, mottled. Soft to moderately hard, iron oxide on fractures. Fracturing indeterminate.
6. CLAYSTONE – dark reddish brown 10R 3/4 soft white in fractures, contains some calcareous nodules.
7. SILTSTONE – moderate reddish brown 10R 4/6 soft to hard. Iron oxide staining on fractures.



LEGEND:

1. ORGANIC TOPSOIL
2. SLOPEWASH, (SW)

KELVIN FORMATION (Kk)

3. SILTSTONE – moderate reddish brown 10R 4/6 soft to moderately hard. Fracturing indeterminate. Some iron oxide staining in fractures.
4. SANDSTONE – pale reddish brown 10R 5/4, medium to fine grained; moderately hard to hard, some fractures contain calcite, some mottling, moderate reddish brown 10R 4/6, some fractures have iron oxide.
5. CLAYSTONE, dark reddish brown 10R 3/4; soft; white in fractures; also contains some calcareous nodules. Fracturing indeterminate.

GRAPHIC SCALE:

0 20' 40' 60'

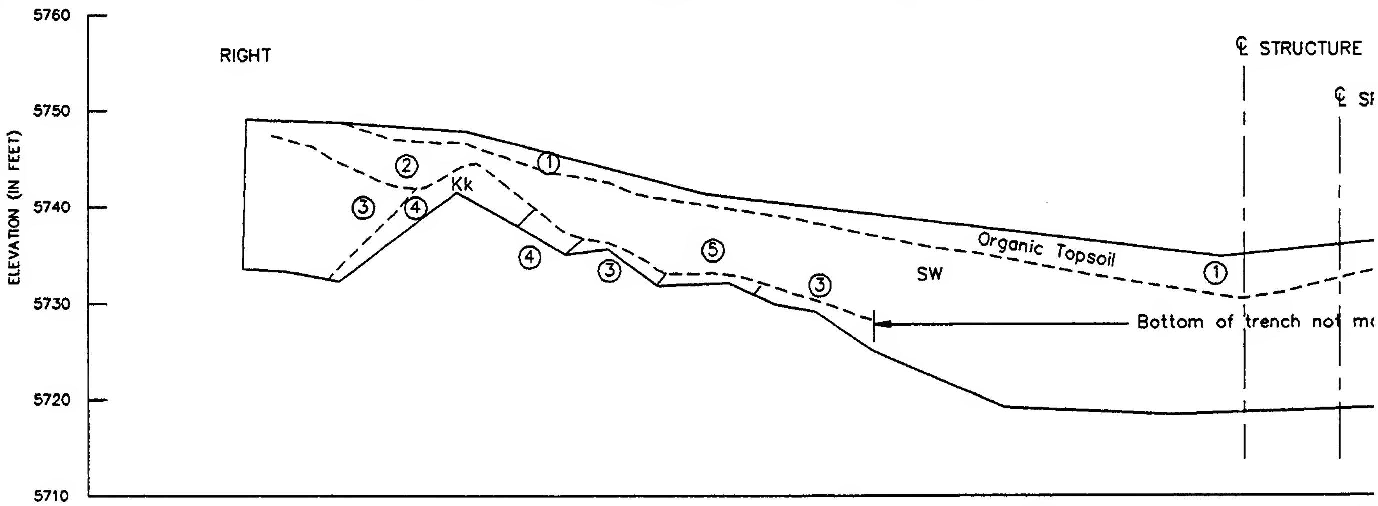
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

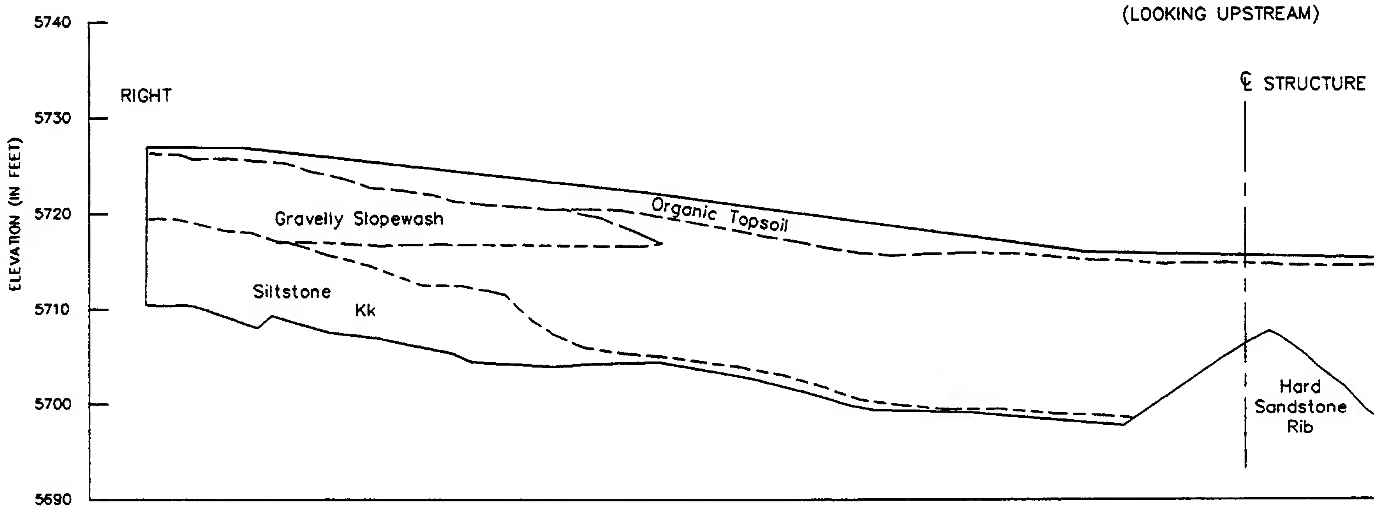
SPILLWAY
EROSION CONTROL STRUCTURES
A AND B

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

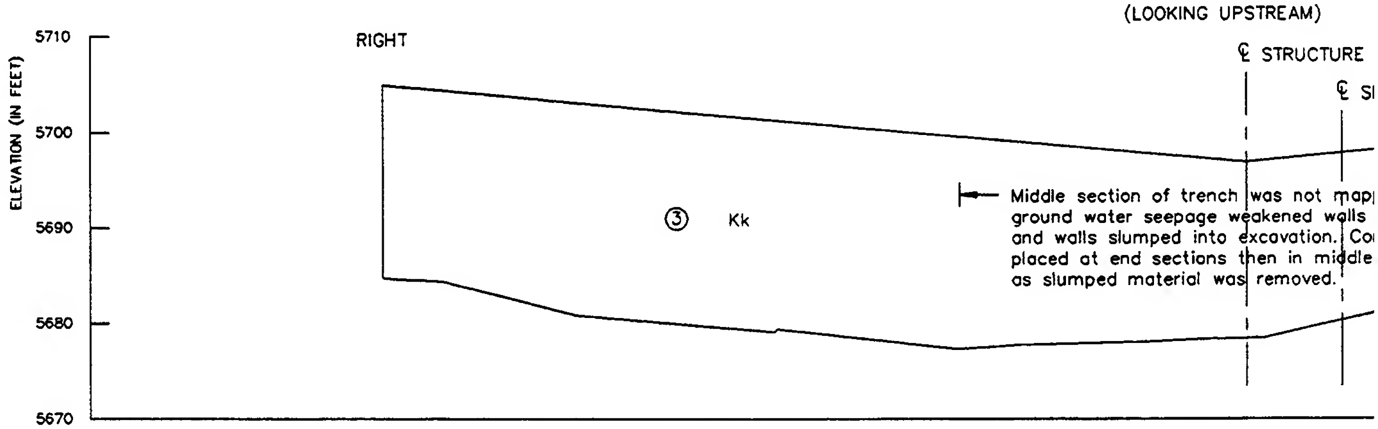
SUBMITTED: Robert L. [illegible] for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER
GEB		BAB	PLATE 48



EROSION CONTROL STRUCTUR
STATION 17+50.10
(LOOKING UPSTREAM)



EROSION CONTROL STRUCTUR
STATION 19+73.64
(LOOKING UPSTREAM)



EROSION CONTROL STRUCTUR
STATION 22+21.46
(LOOKING UPSTREAM)

LEGEND:

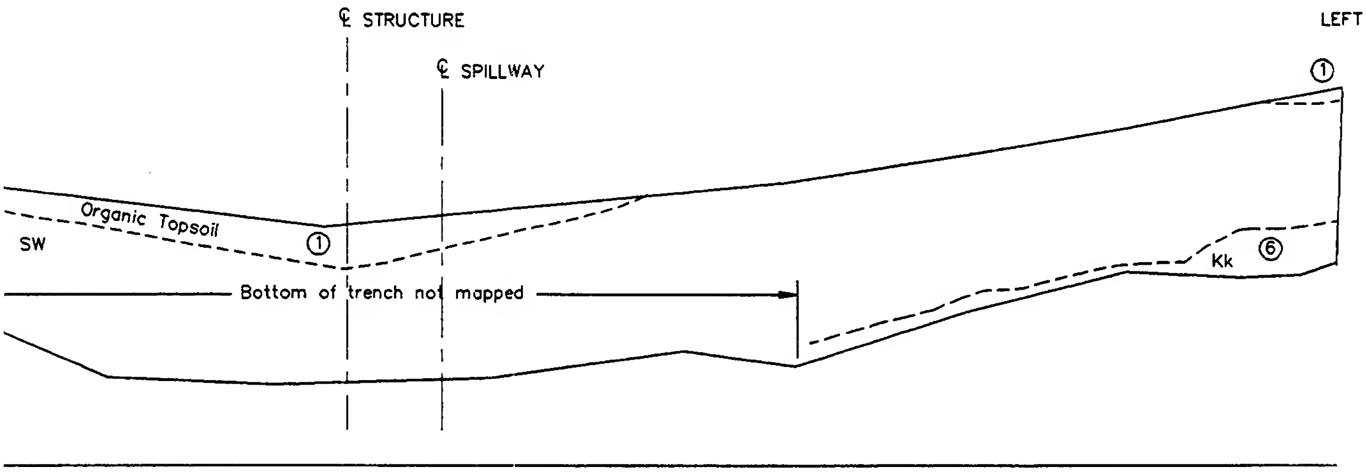
1. ORGANIC TOPSOIL

KELVIN FORMATION (Kk)

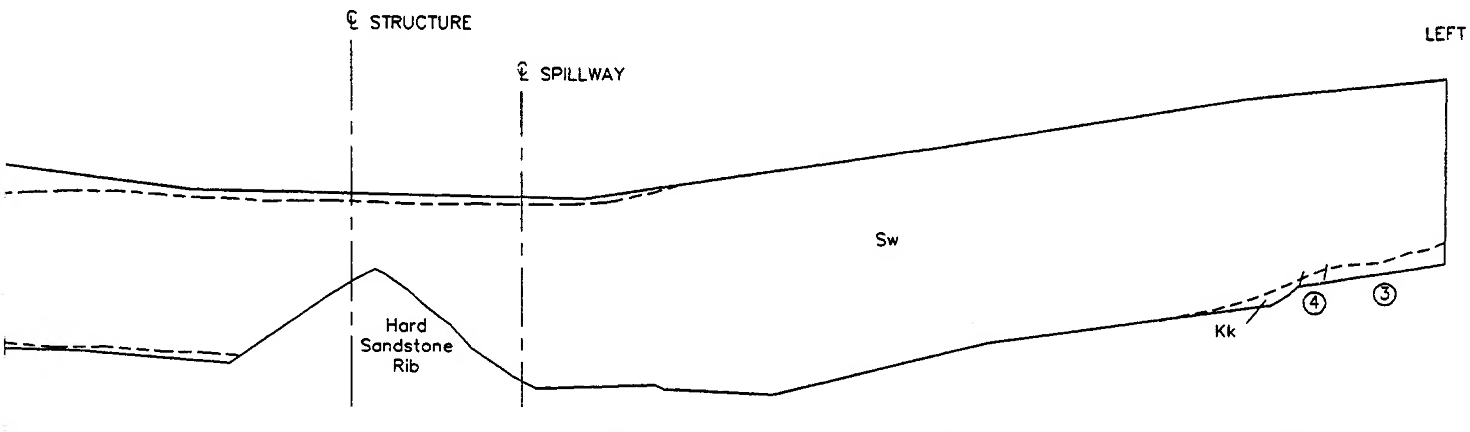
2. SANDSTONE SILTSTONE – Moderate reddish brown 10R 4/6. Sand is fine grained.

3. SANDSTONE – Tan, fine grained.

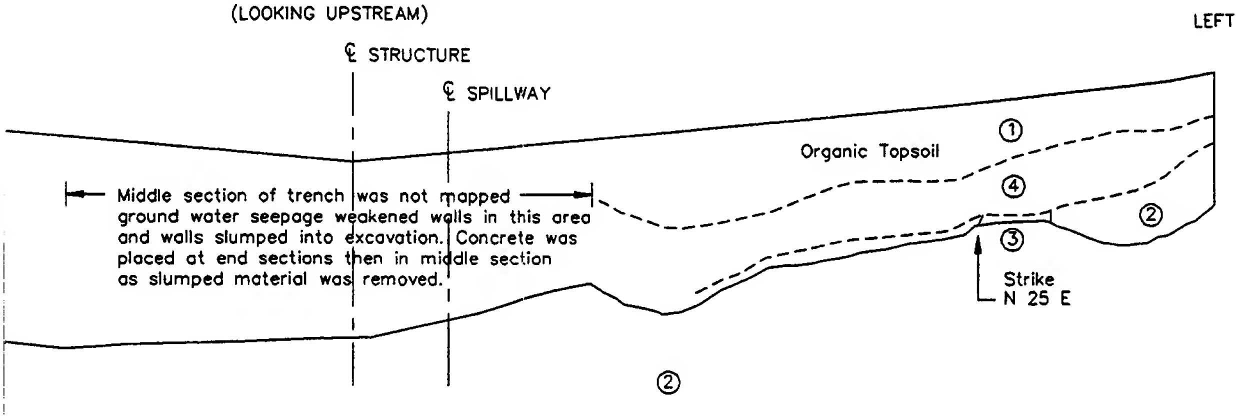
4. CLAY – Moderate brown ,contains some gravel sized fragments of quatrzite.



EROSION CONTROL STRUCTURE "C"
STATION 17+50.10
(LOOKING UPSTREAM)



EROSION CONTROL STRUCTURE "D"
STATION 19+73.64
(LOOKING UPSTREAM)



EROSION CONTROL STRUCTURE "E"
STATION 22+21.46
(LOOKING UPSTREAM)

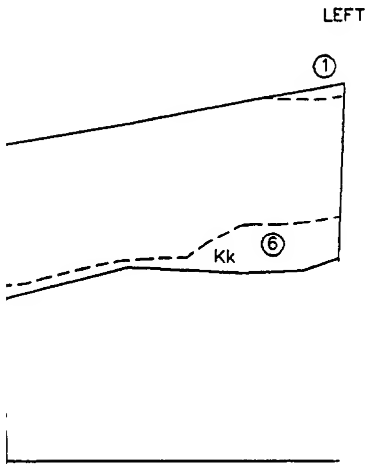
LEGEND:

1. ORGANIC TO
2. SLOPEWASH

KELVIN FORMA

3. SILTSTONE –
and yellowis
moderately
not apparen
4. SANDSTONE
fine graine
oxide staini
determinable
5. SILTSTONE –
moderately
nodules frac
6. SILTY SANDS
yellowish br
fine to very
determinable

SUBMITTED:
CARL
GEB

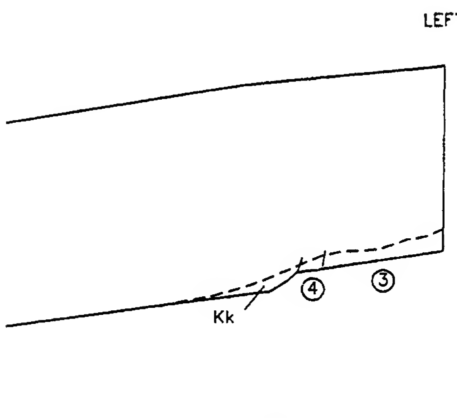


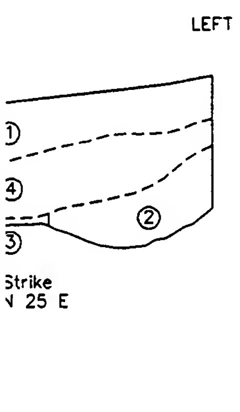
LEGEND:

1. ORGANIC TOPSOIL
2. SLOPEWASH (SW)

KELVIN FORMATION (Kk)

3. SILTSTONE – Moderate reddish brown 10R 4/6 and yellowish gray 5Y 7/2, mottled; soft to moderately hard ; softer near top, fracturing is not apparent due to smearing during excavation.
4. SANDSTONE – moderate reddish orange 10R 6/6; fine grained; moderately hard to hard; some iron oxide staining on fractures; fracture spacing not determinable.
5. SILTSTONE – moderate reddish brown 10R 4/6; moderately hard to hard; contains small calceous nodules fracturing is not determinable.
6. SILTY SANDSTONE – yellowish gray 5Y 7/2 to pale yellowish brown 10Y 6/2; soft to moderately hard; fine to very fine grained; fracturing is not determinable.





GRAPHIC SCALE:

0 20' 40' 60'

(SCALE IN FEET)

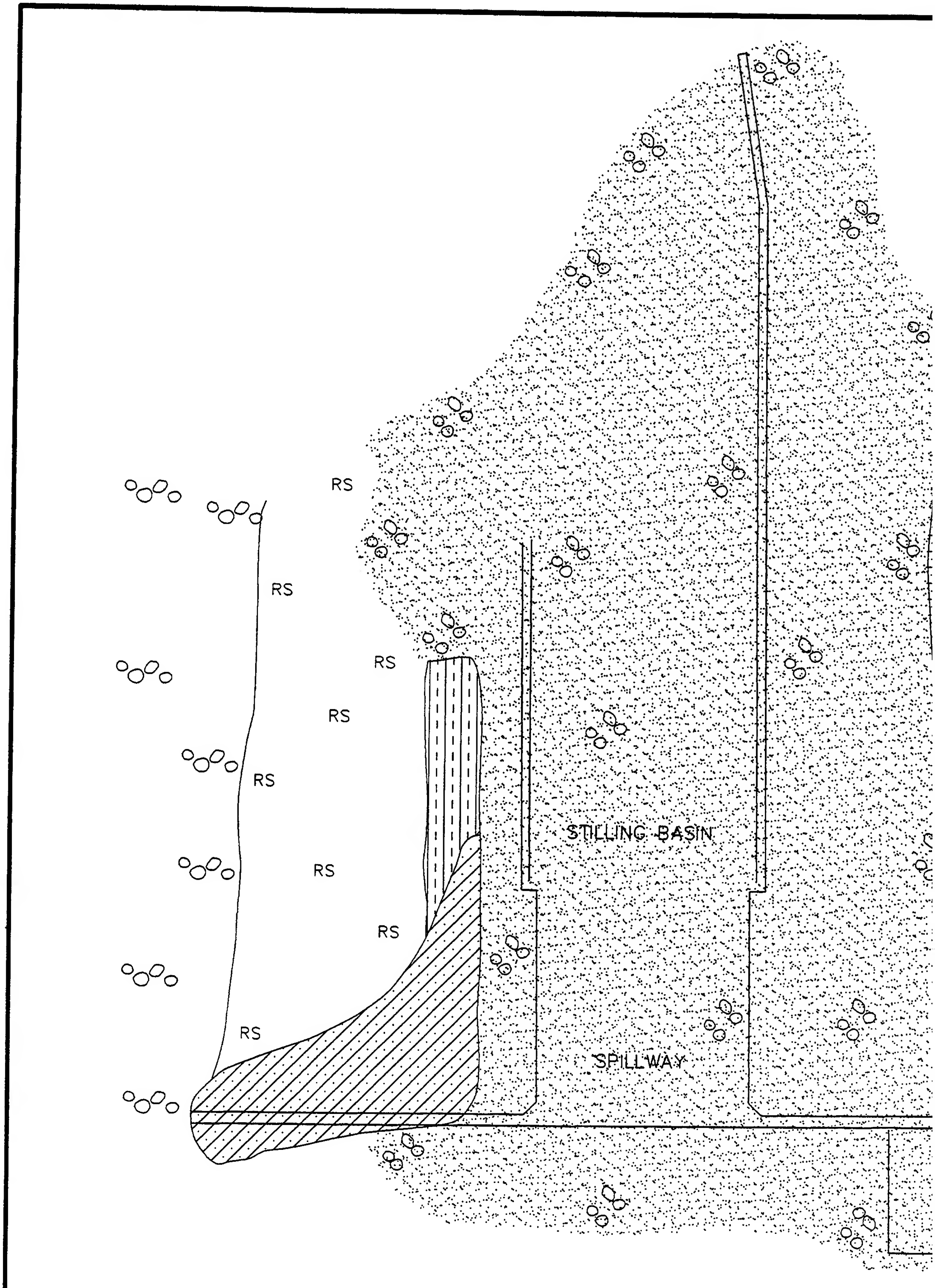
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

SPILLWAY
EROSION CONTROL STRUCTURES
C, D, AND E

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	TR. BY	CKD. BY	FILE No.
GEB		BAB	PLATE 49



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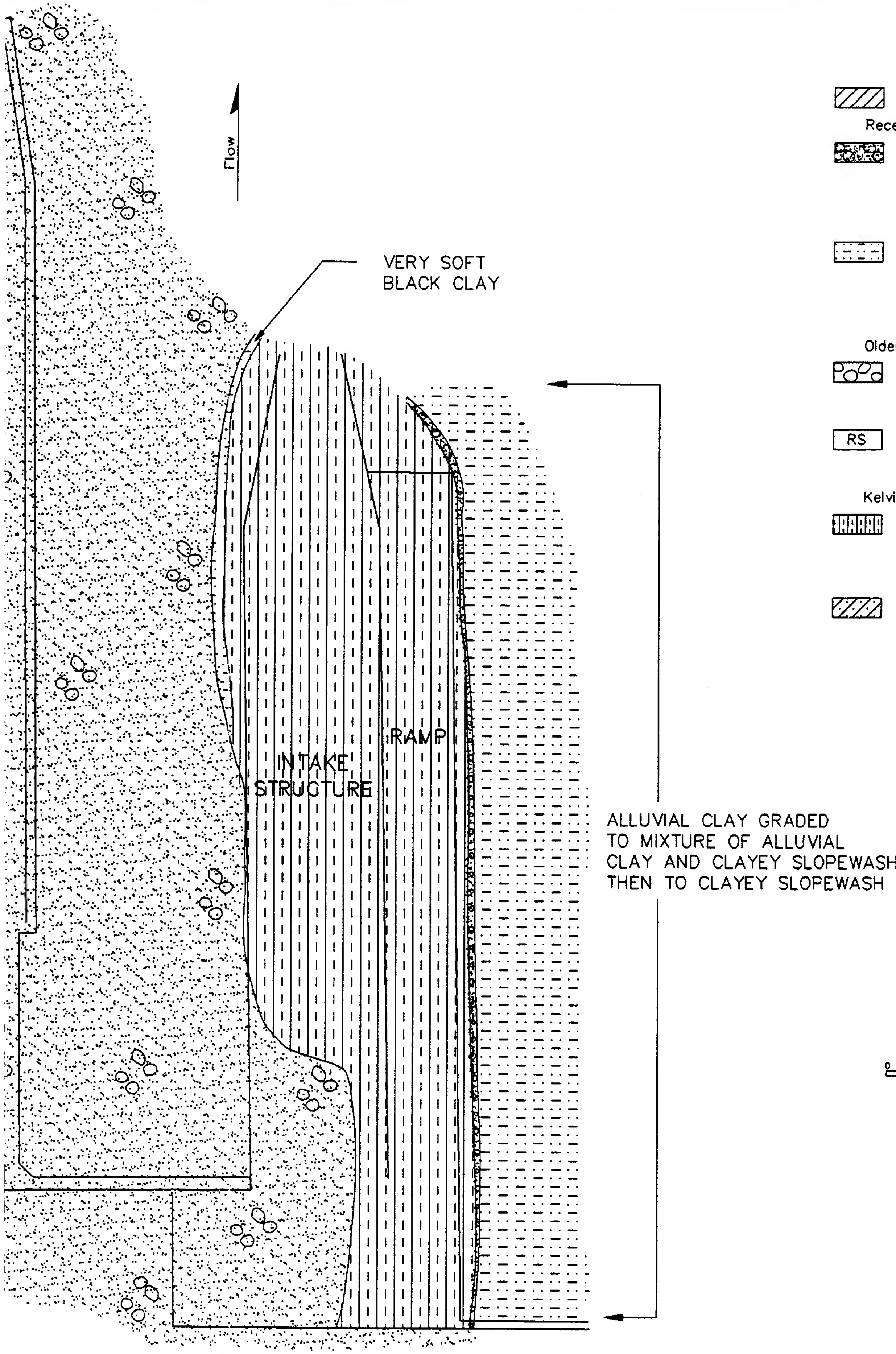


LEGEND:

Slopewash, light brown sandy clay,

Recent Alluvium –

Gravel, cobble and boulder mixtures sandy matrix. Light to dark gray. G dense; minor soft pockets removed replaced with compacted cobbles; r coarse

Clay and sandy clay, dark gray to l brown, very soft and saturated at c stream left (southwest) side of intc structure; soft to firm where mixed slopewash at right (north) side of i

Older Alluvium –

Gravel, cobbles and boulders in a clayey sand matrix, reddish brown, and subrounded coarse poorly sorte

RS Residual Soil – angular soft rock in clayey sand matrix, reddish brown Contains some areas of Recent Allu

Kelvin Formation –

Undifferentiated –
Predominantly silty sandstone and s siltstone with some harder sandstor reddish brown and gray beds, soft

Congolomerate, mulitcolored in gray very soft

GRAPHIC SCALE:

0 20 40

(SCALE IN FEET)

LITTLE DELL LAKE SALT LAKE CITY STREAMS OUTLET WORKS GEOLOGIC MAP PARLEY'S CREEK DIVERSIO			
DEPARTMENT OF THE SACRAMENTO DISTRICT, CORPS OF SACRAMENTO, CALIFORN			
SUBMITTED: Robert L. [illegible] for CARL E. COLE RESIDENT GEOLOGIST		APPRO	
ERE		CEC	

LEGEND:

Slopewash, light brown sandy clay, firm

Recent Alluvium –

Gravel, cobble and boulder mixtures with sandy matrix. Light to dark gray. Generally dense; minor soft pockets removed and replaced with compacted cobbles; rounded, coarse

Clay and sandy clay, dark gray to light brown, very soft and saturated at down-stream left (southwest) side of intake structure; soft to firm where mixed with slopewash at right (north) side of intake

Older Alluvium –

Gravel, cobbles and boulders in a clayey sand matrix, reddish brown, rounded and subrounded coarse poorly sorted, dense

RS — Residual Soil – angular soft rock fragments in clayey sand matrix, reddish brown, firm. Contains some areas of Recent Alluvium

Kelvin Formation –

Undifferentiated – Predominantly silty sandstone and sandy siltstone with some harder sandstone layers; reddish brown and gray beds, soft to hard

Congolomerate, mulitcolored in gray matrix, very soft

ALLUVIAL CLAY GRADED TO MIXTURE OF ALLUVIAL CLAY AND CLAYEY SLOPEWASH THEN TO CLAYEY SLOPEWASH

N

GRAPHIC SCALE:

0 20 40 60

(SCALE IN FEET)

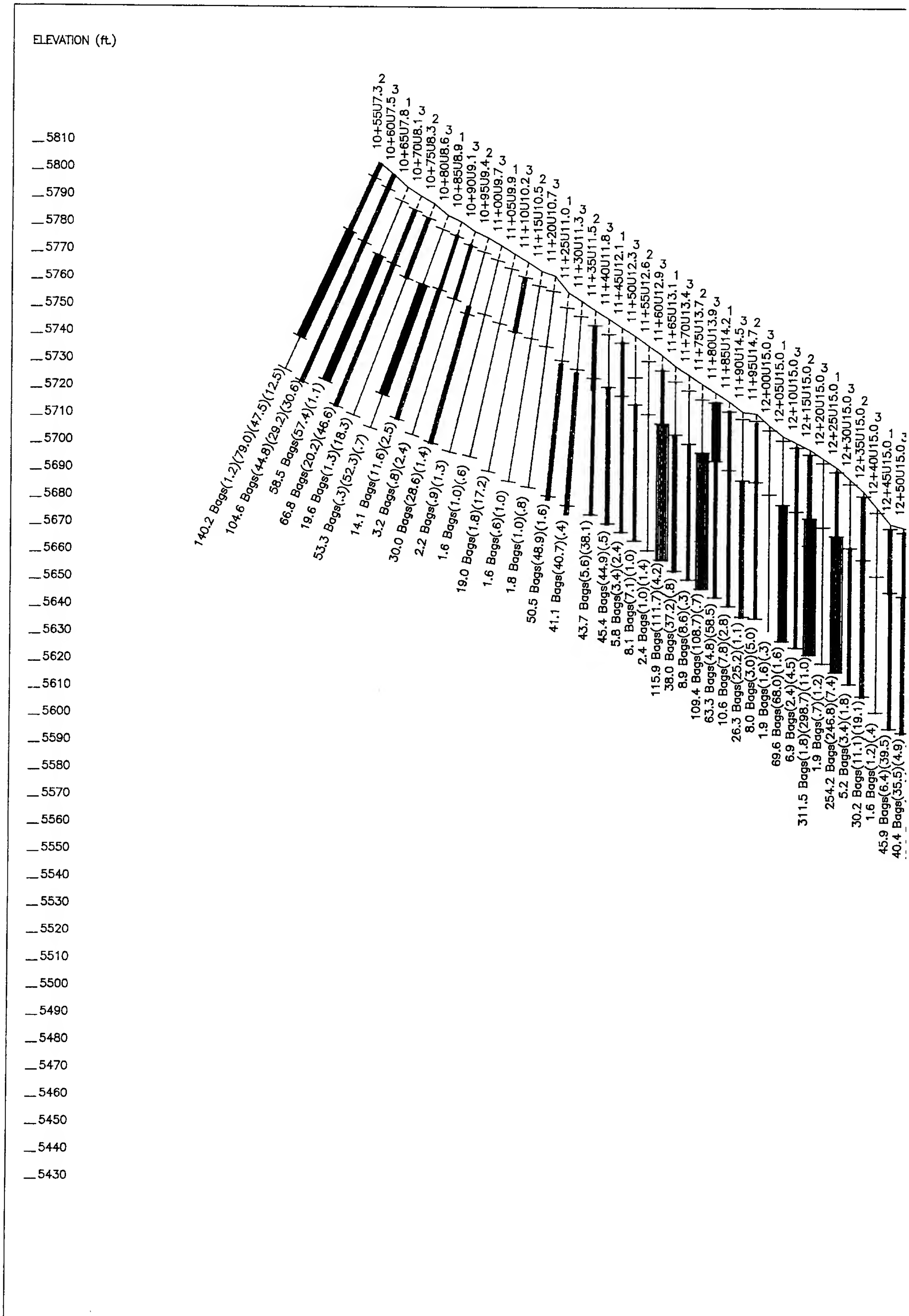
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
GEOLOGIC MAP OF
PARLEY'S CREEK DIVERSION STRUCTURE

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	CK. BY	GEOL. BY	FILE No.
ERE		CEC	PLATE 50


ELEVATION (ft.)
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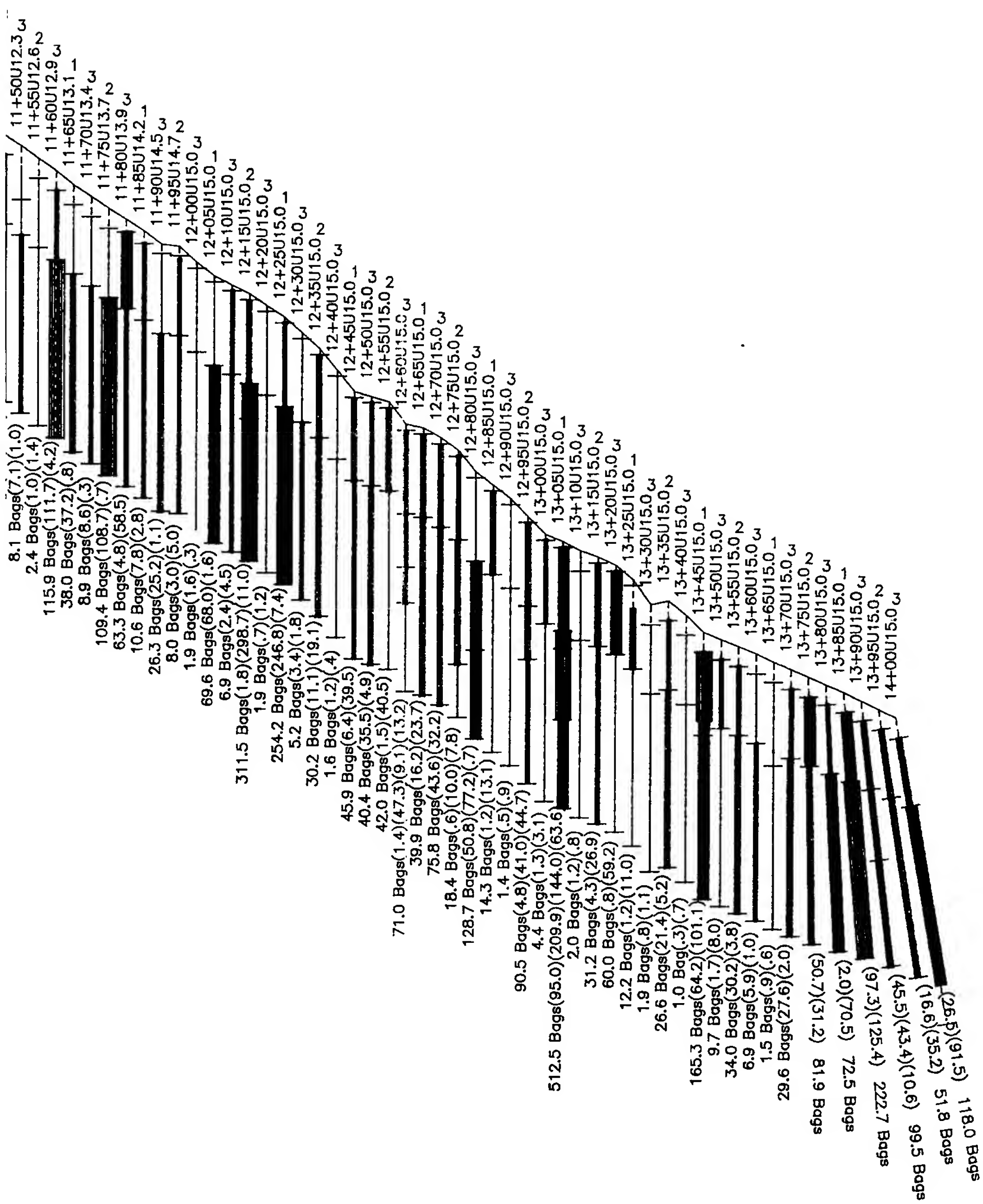
10+55U7.3 2
10+60U7.5 3
10+65U7.8 1
10+70U8.1 3
10+75U8.3 2
10+80U8.6 3
10+85U8.9 1
10+90U9.1 3
10+95U9.4 2
11+00U9.7 3
11+05U9.9 1
11+10U10.2 3
11+15U10.5 2
11+20U10.7 3
11+25U11.0 1
11+30U11.3 3
11+35U11.5 2
11+40U11.8 3
11+45U12.1 1
11+50U12.3 3
11+55U12.6 2
11+60U12.9 3
11+65U13.1 1
11+70U13.4 3
11+75U13.7 2
11+80U13.9 3
11+85U14.2 1
11+90U14.5 3
11+95U14.7 2
12+00U15.0 3
12+05U15.0 1
12+10U15.0 3
12+15U15.0 2
12+20U15.0 3
12+25U15.0 1
12+30U15.0 3
12+35U15.0 2
12+40U15.0 3
12+45U15.0 1
12+50U15.0 3
140.2 Bags(1.2)(79.0)(47.5)(12.5)
104.6 Bags(44.8)(29.2)(30.6)
58.5 Bags(57.4)(1.1)
66.8 Bags(20.2)(46.6)
19.6 Bags(1.3)(18.3)
53.3 Bags(.3)(52.3)(.7)
14.1 Bags(11.6)(2.5)
3.2 Bags(.8)(2.4)
30.0 Bags(28.6)(1.4)
2.2 Bags(.9)(1.3)
1.6 Bags(1.0)(.6)
19.0 Bags(1.8)(17.2)
1.6 Bags(.6)(1.0)
1.8 Bags(1.0)(.8)
50.5 Bags(48.9)(1.6)
41.1 Bags(40.7)(.4)
43.7 Bags(5.6)(38.1)
45.4 Bags(44.9)(.5)
5.8 Bags(3.4)(2.4)
8.1 Bags(7.1)(1.0)
2.4 Bags(1.0)(1.4)
115.9 Bags(111.7)(4.2)
38.0 Bags(37.2)(.8)
8.9 Bags(8.6)(.3)
109.4 Bags(108.7)(.7)
63.3 Bags(4.8)(58.5)
10.6 Bags(7.8)(2.8)
26.3 Bags(25.2)(1.1)
8.0 Bags(3.0)(5.0)
1.9 Bags(1.6)(.3)
69.6 Bags(68.0)(1.6)
6.9 Bags(2.4)(4.5)
311.5 Bags(1.8)(298.7)(11.0)
1.9 Bags(.7)(1.2)
254.2 Bags(246.8)(7.4)
5.2 Bags(3.4)(1.8)
30.2 Bags(11.1)(19.1)
1.6 Bags(1.2)(.4)
45.9 Bags(6.4)(39.5)
40.4 Bags(35.5)(4.9)



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 1 — Category (Primary) — Hole number

No Data Available

STAGE take (Less than

Start of STAGE

STAGE take (2 – 10 b

End of STAGE

STAGE take (10 – 50

STAGE take (50 – 100

STAGE take (100+ bags

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout tak

0 50'

1 Inch = 50

SALT L

FOUNDAT

HOLE

EXCLUDING

CORPS

SACRAMENTO DI

SUBMITTED: Robert L. Tre

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	G

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10[1]

Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0)

Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

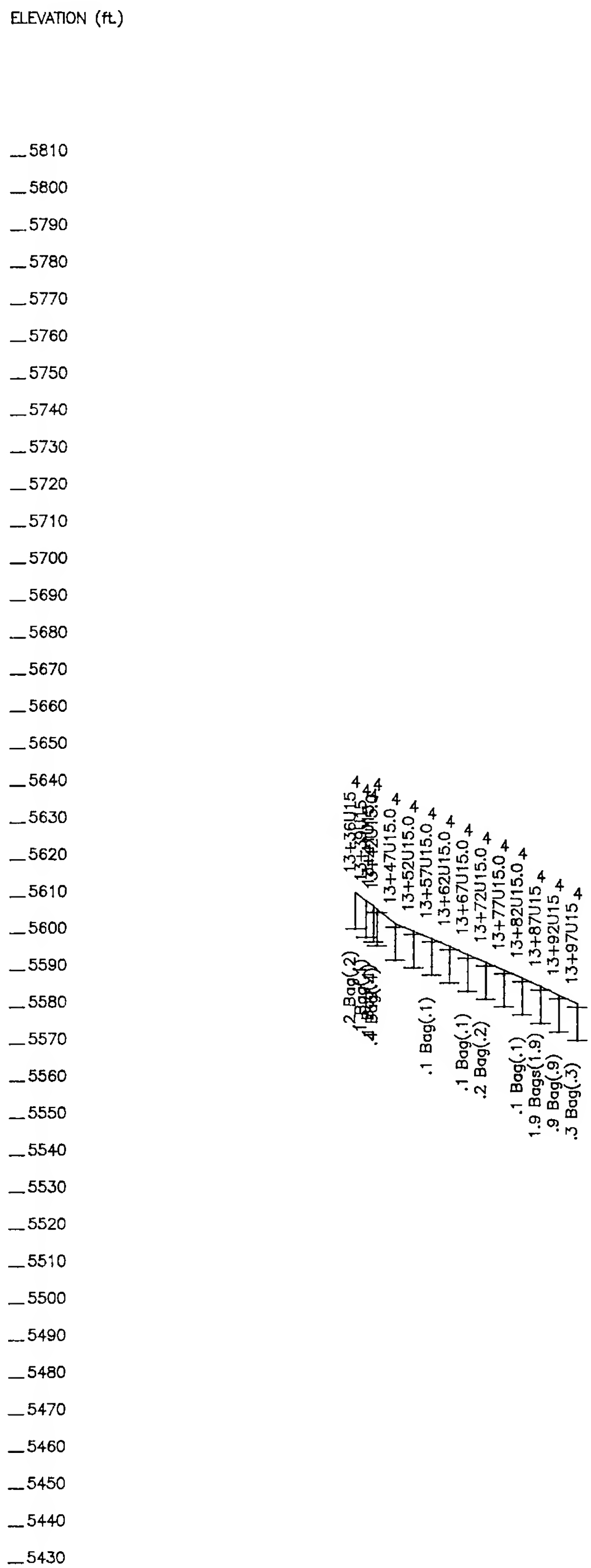
FOUNDATION GROUT CURTAIN

HOLES A1050–A1400

EXCLUDING QUATERNARY HOLES

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: for [signature] PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 51



NOTE:

FOR THOSE HO
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1 Prir
2 Sec
3 Ter
4 Quc
5 Etc.

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NOTE:

FOR THOSE HOLES WHICH PLOT TOO CLOSE TOGETHER FOR THE INFORMATION TO BE LEGIBLE, PLEASE REFER TO THE APPROPRIATE SECTION OF TABLE 6.

SUBMITTED

PLOTTED BY:

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

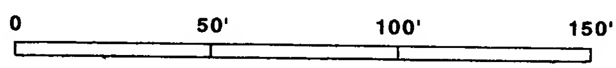
STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

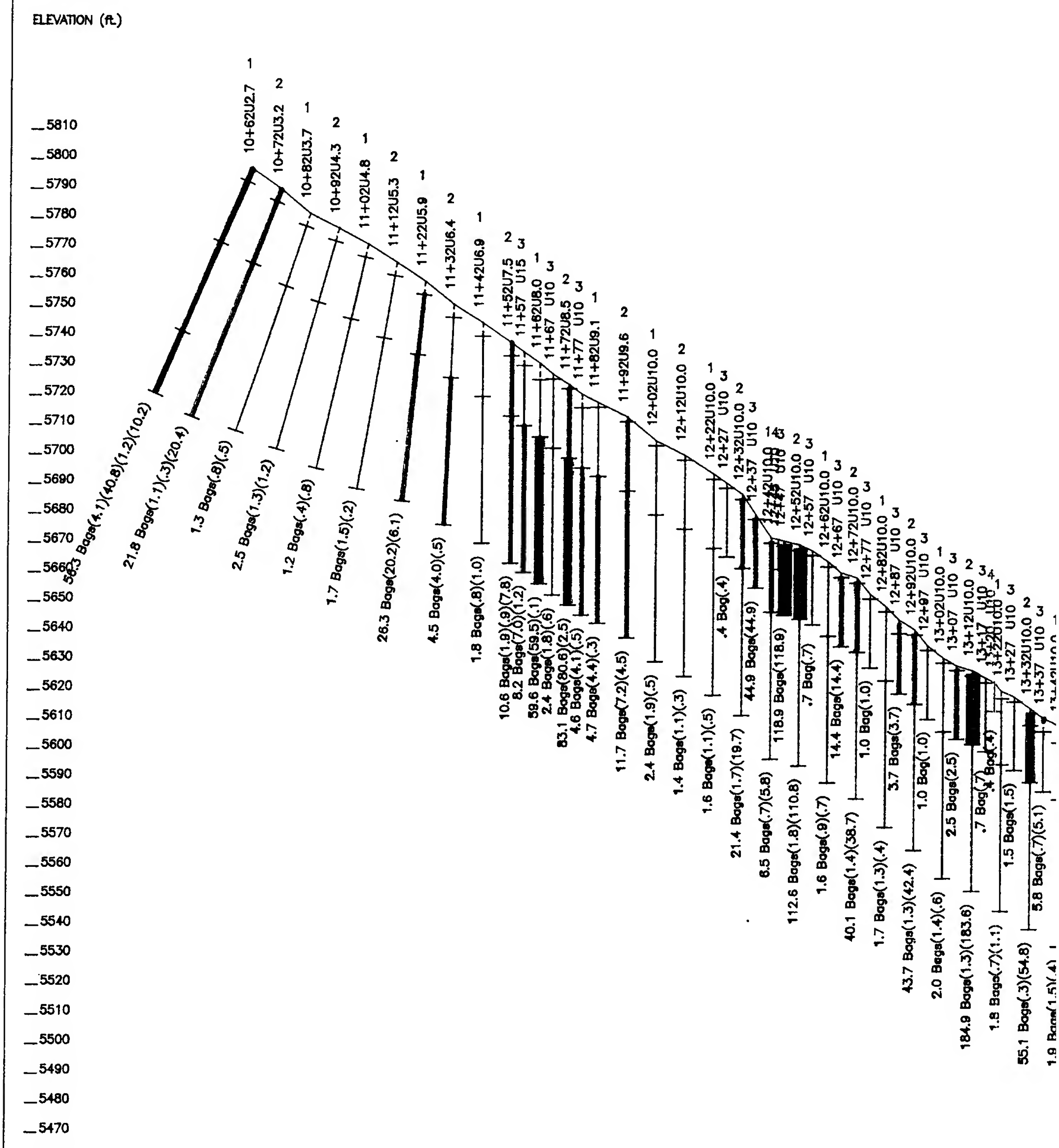
Depth of hole

Total grout take in bags



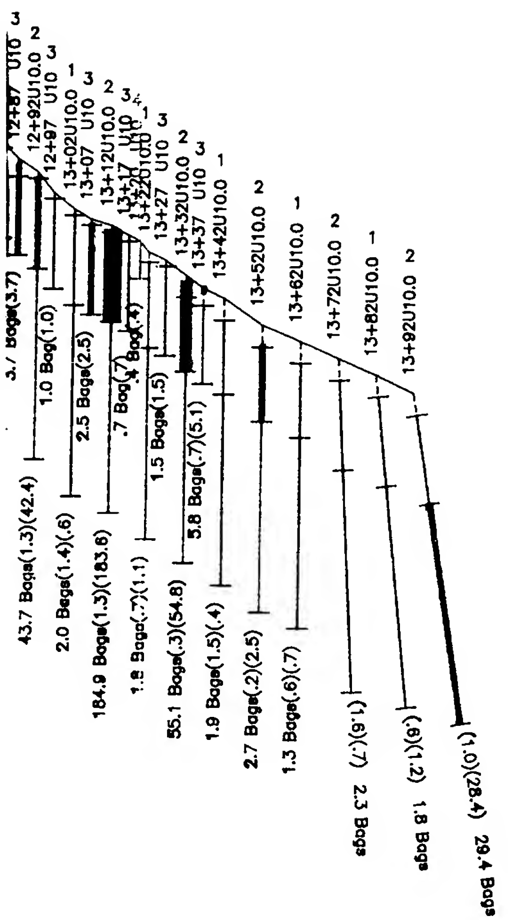
1 Inch = 50 Feet

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH FOUNDATION GROUT CURTAIN HOLES A1050–A1400 QUATERNARY HOLES			
CORPS OF ENGINEERS, U.S. ARMY SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA			
SUBMITTED: Robert L. Treat for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Carnegie PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 52



NOTE:

FOR THOSE HOLES WHICH PLOT TOO CLOSE TOGETHER FOR THE INFORMATION TO BE LEGIBLE PLEASE REFER TO THE APPROPRIATE SECTION O



T TOO CLOSE
ON TO BE LEGIBLE,
RIATE SECTION OF TABLE 6.

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

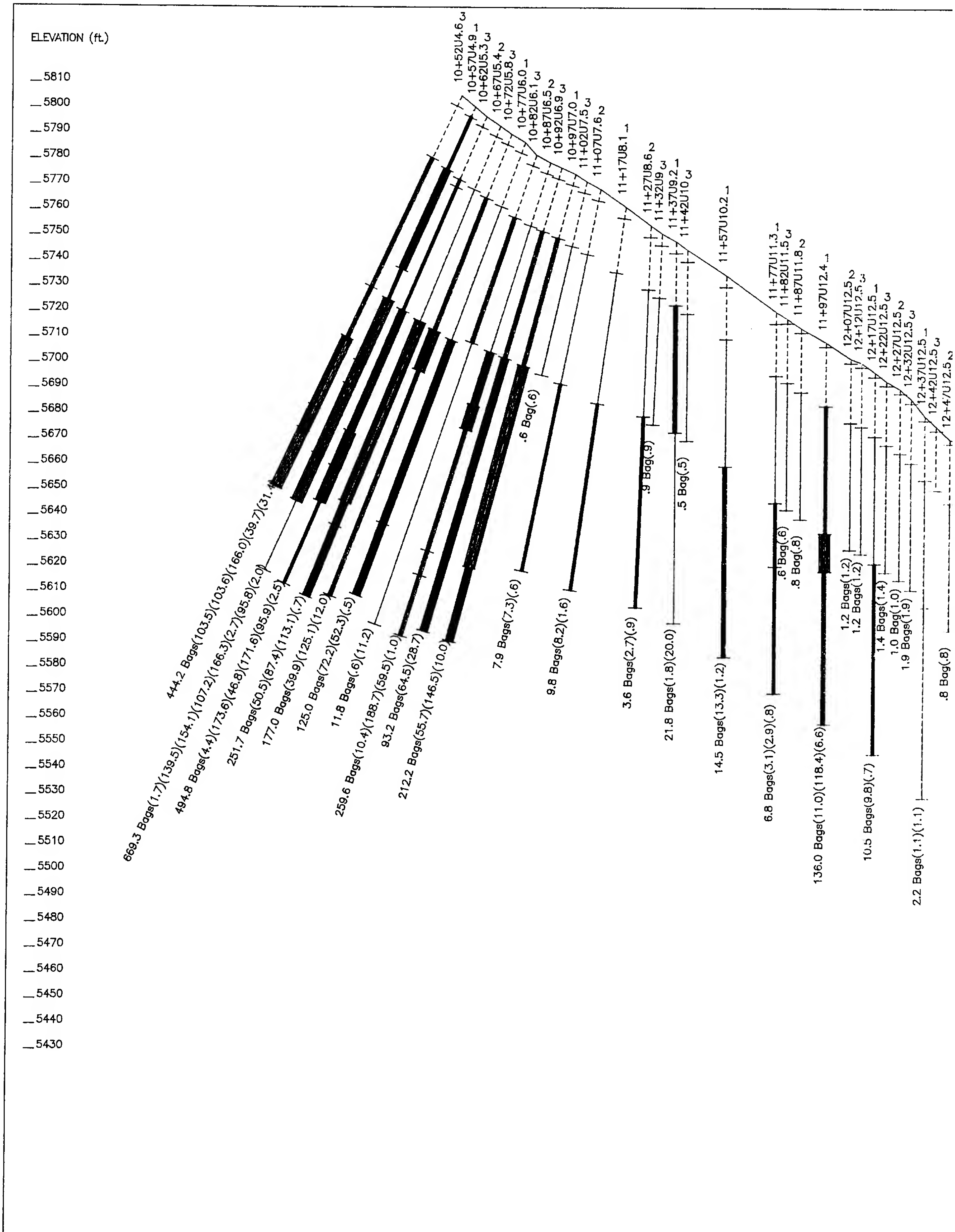
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

HOLES B1050–B1400

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost			APPROVED: for John Lonigan
CARL E. COLE RES. GEOLOGIST			PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 53


ELEVATION (ft.)
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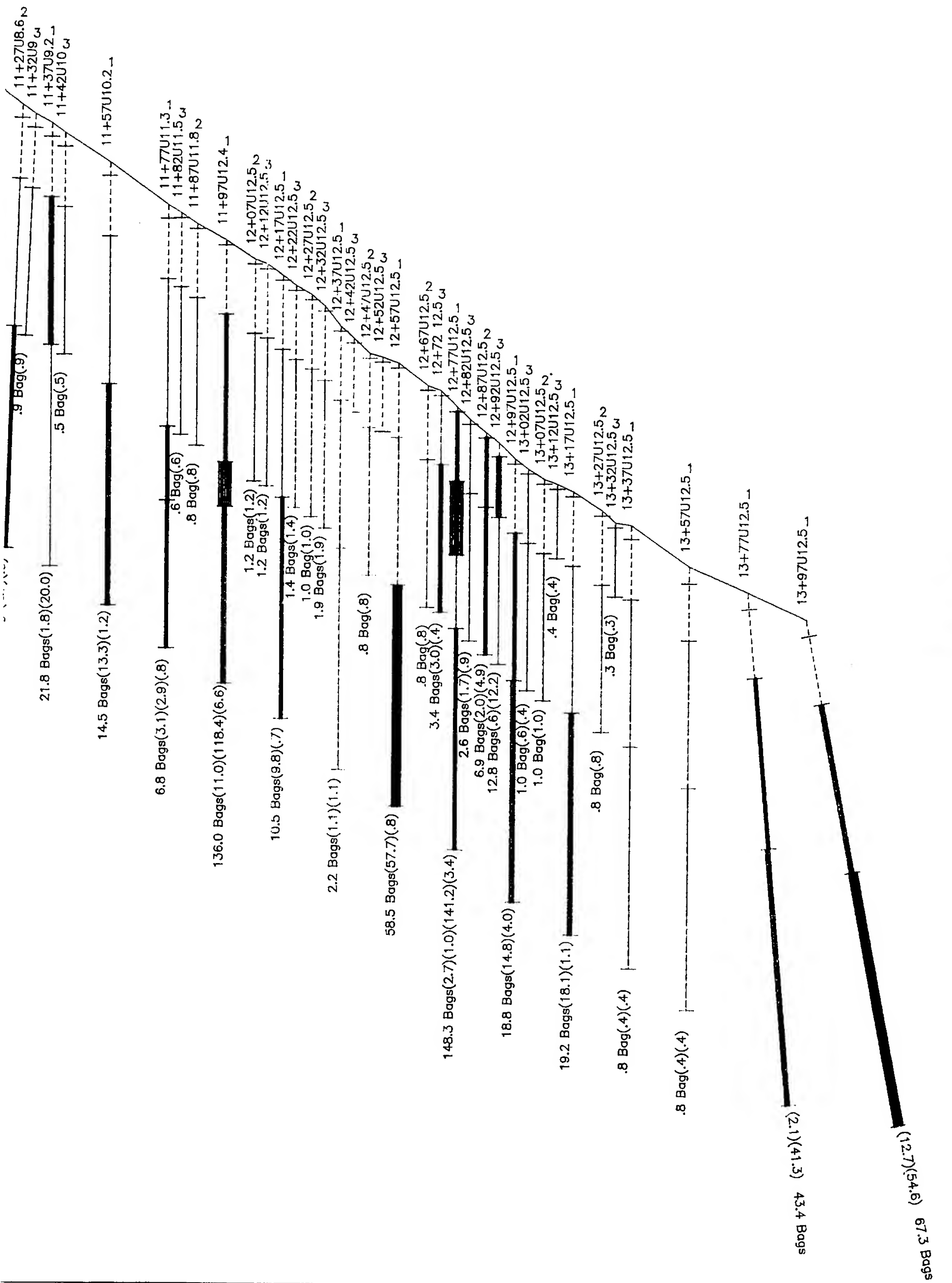
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
10+52U4.6 3
10+57U4.9 1
10+62U5.3 3
10+67U5.4 2
10+72U5.8 3
10+77U6.0 1
10+82U6.1 3
10+87U6.5 2
10+92U6.9 3
10+97U7.0 1
11+02U7.5 3
11+07U7.6 2
11+17U8.1 1
11+27U8.6 2
11+32U9 3
11+37U9.2 1
11+42U10 3
11+57U10.2 1
11+77U11.3 1
11+82U11.5 3
11+87U11.8 2
11+97U12.4 1
12+07U12.5 2
12+12U12.5 3
12+17U12.5 1
12+22U12.5 3
12+27U12.5 2
12+32U12.5 3
12+37U12.5 1
12+42U12.5 3
12+47U12.5 2
444.2 Bags(103.5)(103.6)(166.0)(39.7)(31.
669.3 Bags(1.7)(139.5)(154.1)(107.2)(166.3)(2.7)(95.8)(2.0)
494.8 Bags(4.4)(173.6)(46.8)(171.6)(95.9)(2.5)
251.7 Bags(50.5)(87.4)(113.1)(.7)
177.0 Bags(39.9)(125.1)(12.0)
125.0 Bags(72.2)(52.3)(.5)
11.8 Bags(.6)(11.2)
259.6 Bags(10.4)(188.7)(59.5)(1.0)
93.2 Bags(64.5)(28.7)
212.2 Bags(55.7)(146.5)(10.0)
.6 Bag(.6)
7.9 Bags(7.3)(.6)
9.8 Bags(8.2)(1.6)
.9 Bag(.9)
3.6 Bags(2.7)(.9)
.5 Bag(.5)
21.8 Bags(1.8)(20.0)
14.5 Bags(13.3)(1.2)
.6 Bag(.6)
.8 Bag(.8)
6.8 Bags(3.1)(2.9)(.8)
136.0 Bags(11.0)(118.4)(6.6)
1.2 Bags(1.2)
1.2 Bags(1.2)
10.5 Bags(9.8)(.7)
1.4 Bags(1.4)
1.0 Bag(1.0)
1.9 Bags(1.9)
2.2 Bags(1.1)(1.1)
.8 Bag(.8)



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 1 — Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/ST

Start of STAGE

STAGE take (2 – 10 bags/STAGE

End of STAGE

STAGE take (10 – 50 bags/STA

STAGE take (50 – 100 bags/STA

STAGE take (100+ bags/STAGE)

Depth of hole

Total grout take in b

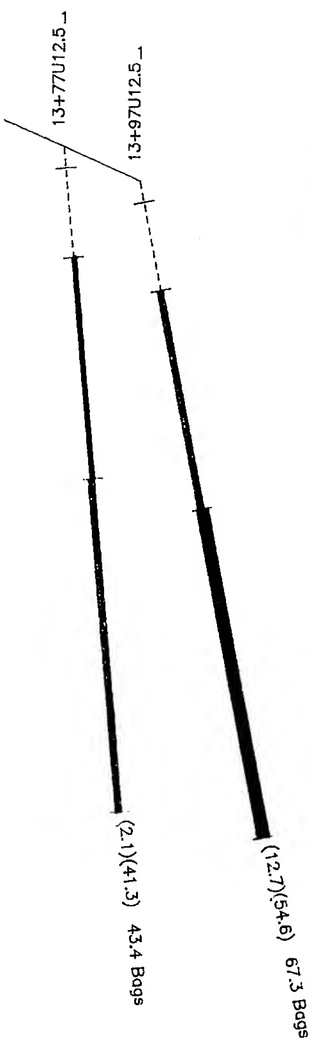
150.0 Bags(101.0)(49.0)

0 50'

1 Inch = 50 Feet

LITTLE DEL SALT LAKE CITY S FOUNDATION GR HOLES C105 EXCLUDING QUATI
CORPS OF ENGINEE SACRAMENTO DISTRICT, SA
SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10_1
Category (Primary)
Hole number

No Data Available
STAGE take (Less than 2 Bags/STAGE)
Start of STAGE
STAGE take (2 – 10 bags/STAGE)
End of STAGE
STAGE take (10 – 50 bags/STAGE)
STAGE take (50 – 100 bags/STAGE)
STAGE take (100+ bags/STAGE)
Depth of hole

150.0 Bags(101.0)(49.0)
Total grout take in bags

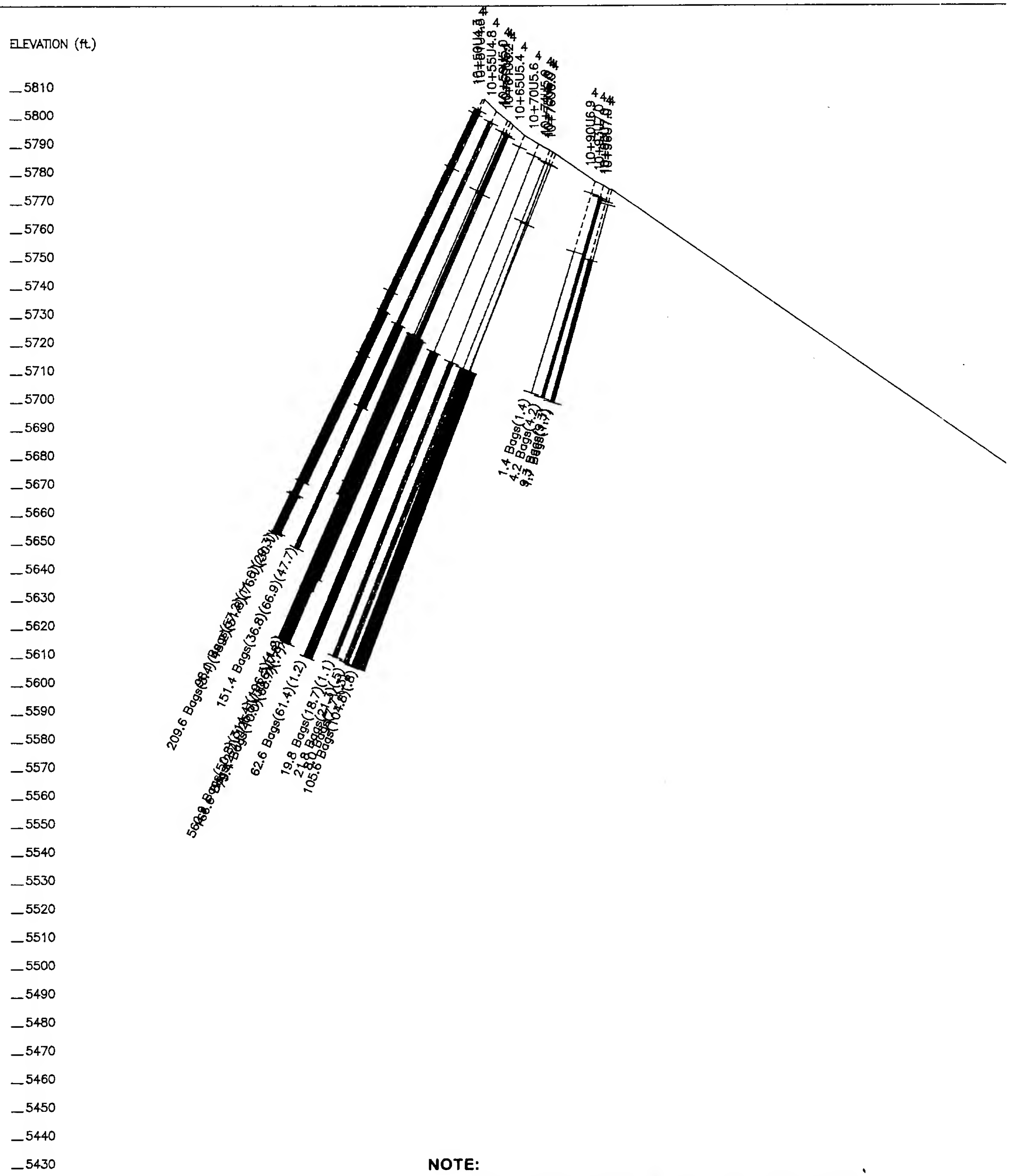
0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN
HOLES C1050–C1400
EXCLUDING QUATERNARY HOLES

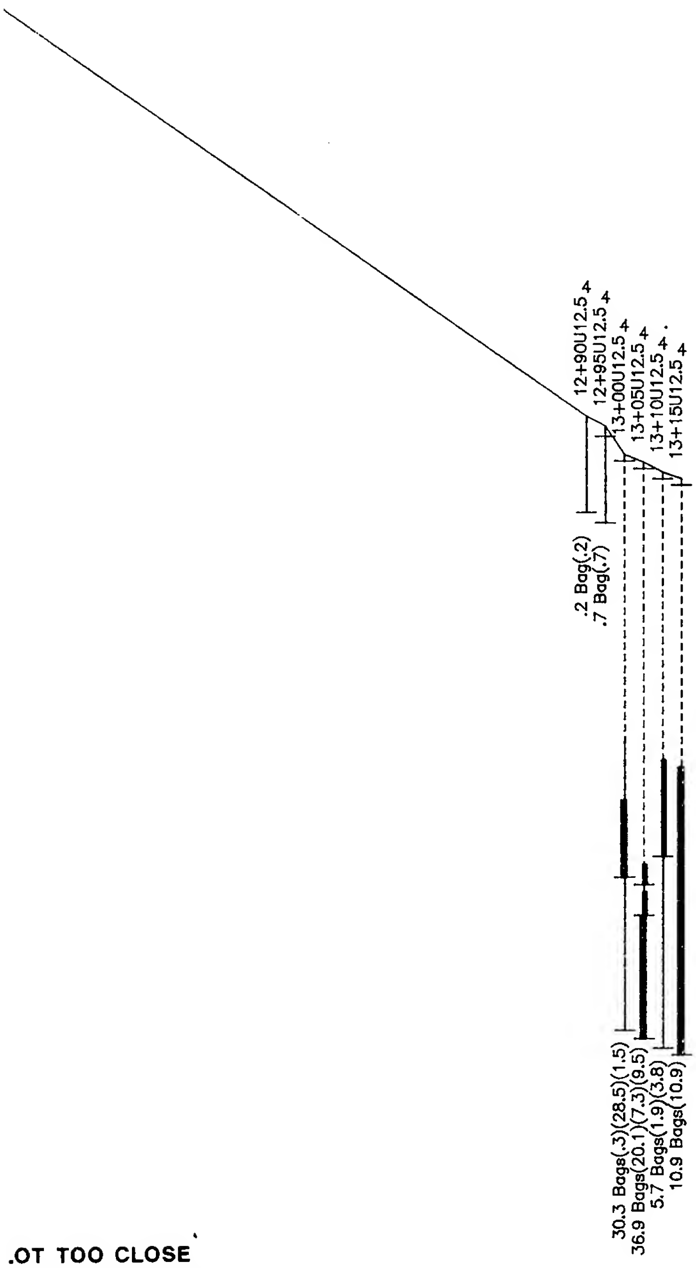
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Carrigan PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 54



NOTE:

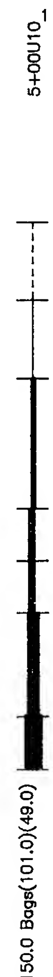
FOR THOSE HOLES WHICH PLOT TOO CLOSE TOGETHER FOR THE INFORMATION TO BE LEGIBLE, PLEASE REFER TO THE APPROPRIATE SECTION OF TABLE 6.



.OT TOO CLOSE
ATION TO BE LEGIBLE,
ROPRIATE SECTION OF TABLE 6.

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.



Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

Total grout take in bags

0 50'

1 Inch = 50 Feet

LITTLE DELL LAK
SALT LAKE CITY STREAM
FOUNDATION GROU
HOLES C1050–
QUARTERNARY

CORPS OF ENGINEERS, U
SACRAMENTO DISTRICT, SACRAME

SUBMITTED: Robert L. Ivey for CARL E. COLE, RES. GEOLOGIST			APP
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 1 — Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

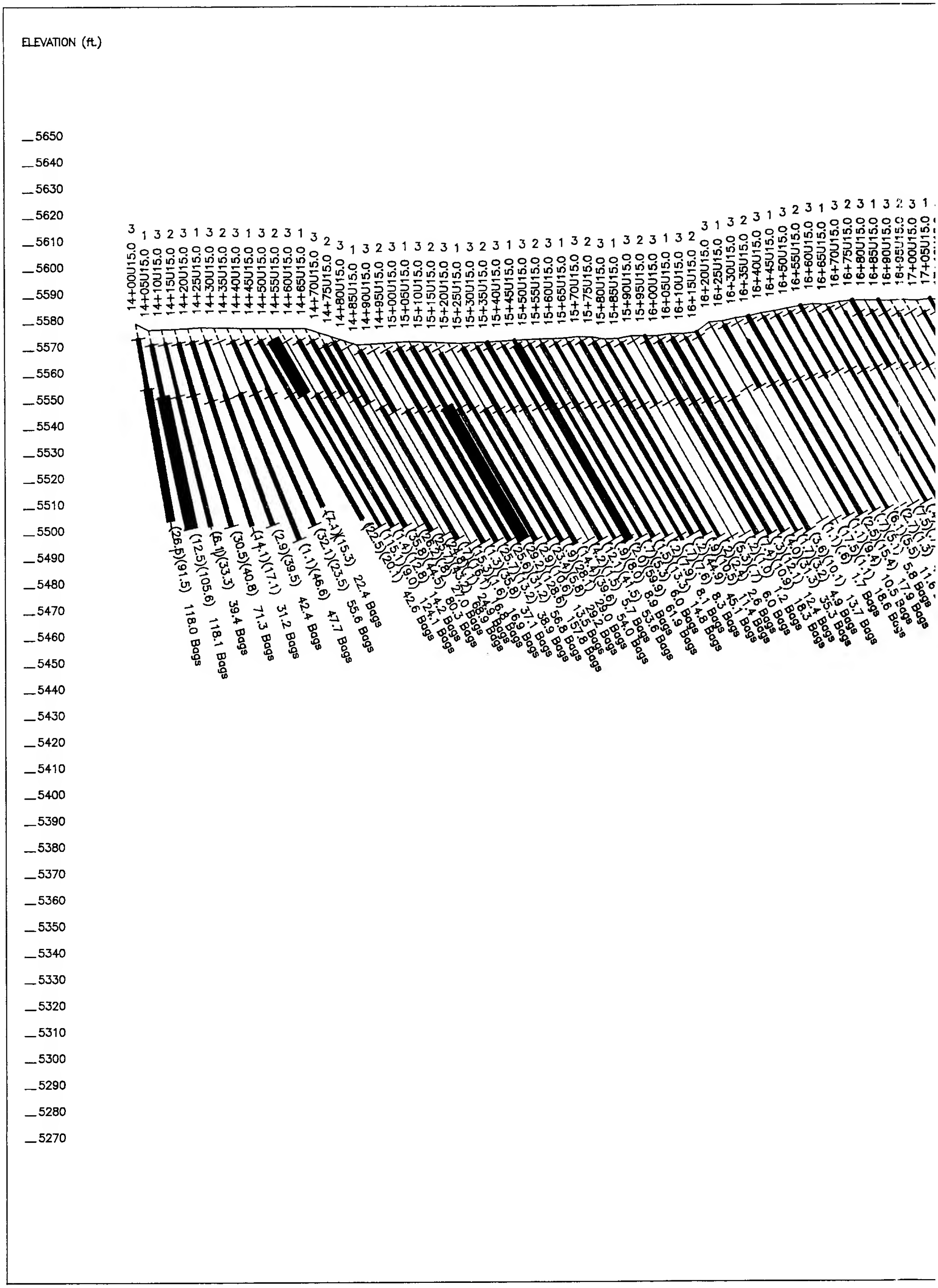
HOLES C1050–C1400

QUARTERNARY HOLES

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Jrest for CARL E. COLE, RES. GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 55


ELEVATION (ft.)
5650
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5290
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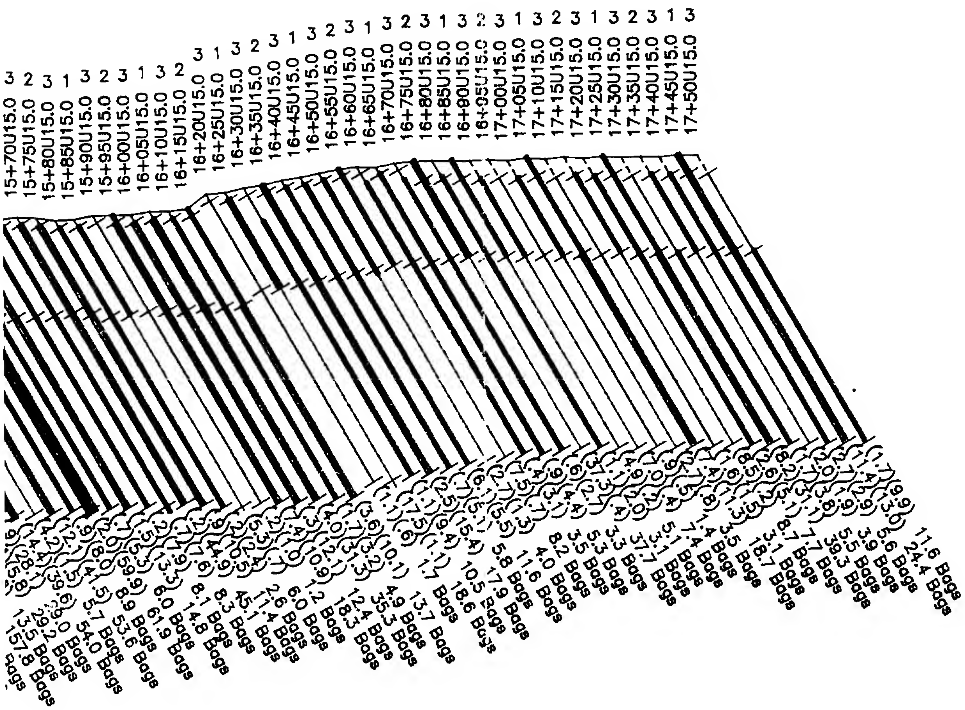
14+05U15.0
14+10U15.0
14+15U15.0
14+20U15.0
14+25U15.0
14+30U15.0
14+35U15.0
14+40U15.0
14+45U15.0
14+50U15.0
14+55U15.0
14+60U15.0
14+65U15.0
14+70U15.0
14+75U15.0
14+80U15.0
14+85U15.0
14+90U15.0
14+95U15.0
15+00U15.0
15+05U15.0
15+10U15.0
15+15U15.0
15+20U15.0
15+25U15.0
15+30U15.0
15+35U15.0
15+40U15.0
15+45U15.0
15+50U15.0
15+55U15.0
15+60U15.0
15+65U15.0
15+70U15.0
15+75U15.0
15+80U15.0
15+85U15.0
15+90U15.0
15+95U15.0
16+00U15.0
16+05U15.0
16+10U15.0
16+15U15.0
16+20U15.0
16+25U15.0
16+30U15.0
16+35U15.0
16+40U15.0
16+45U15.0
16+50U15.0
16+55U15.0
16+60U15.0
16+65U15.0
16+70U15.0
16+75U15.0
16+80U15.0
16+85U15.0
16+90U15.0
16+95U15.0
17+00U15.0
17+05U15.0
(26.5)(91.5) 118.0 Bags
(12.5)(105.6) 118.1 Bags
(6.1)(33.3) 39.4 Bags
(30.5)(40.8) 71.3 Bags
(14.1)(17.1) 31.2 Bags
(2.9)(39.5) 42.4 Bags
(1.1)(46.6) 47.7 Bags
(32.1)(23.5) 55.6 Bags
(7.1)(15.3) 22.4 Bags



LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

Hole number

No Data Available

STAGE take (Less t

Start of STAGE

STAGE take (2 –

End of STAGE

STAGE take (10 –

STAGE take (50 –

STAGE take (100+

Depth of hole

Total grout

0

1 Inch =

FOUN

H

EXCLU

C

SACRAME

SUBMITTED: Robert L.

for CARL E. COL

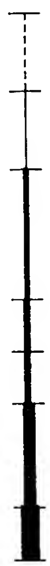
RES. GEOLOGI

PLOTTED BY:	CHECKED BY:

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number



No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

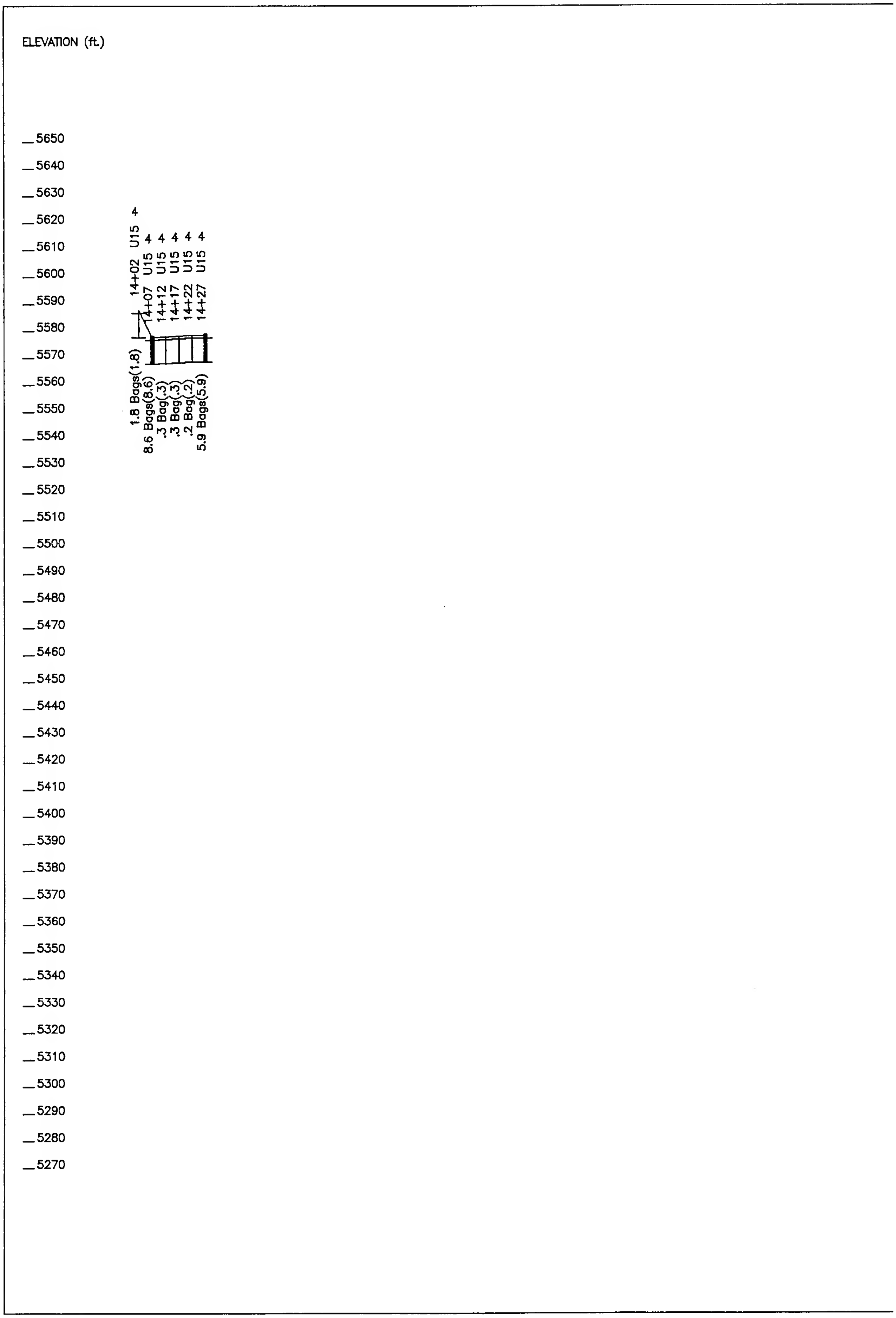
FOUNDATION GROUT CURTAIN

HOLES A1400–A1750

EXCLUDING QUATERNARY HOLES

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

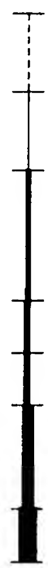
SUBMITTED: Robert L. Frost			APPROVED: for John Carrigan
for CARL E. COLE, RES. GEOLOGIST			PAUL M. PARSONEAULT, RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 56


ELEVATION (ft.)
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
5320
5310
5300
5290
5280
5270
14+02 U15 4
14+07 U15 4
14+12 U15 4
14+17 U15 4
14+22 U15 4
14+27 U15 4
1.8 Bags(1.8)
8.6 Bags(8.6)
.3 Bag(.3)
.3 Bag(.3)
.2 Bag(.2)
5.9 Bags(5.9)

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 — Hole number



No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

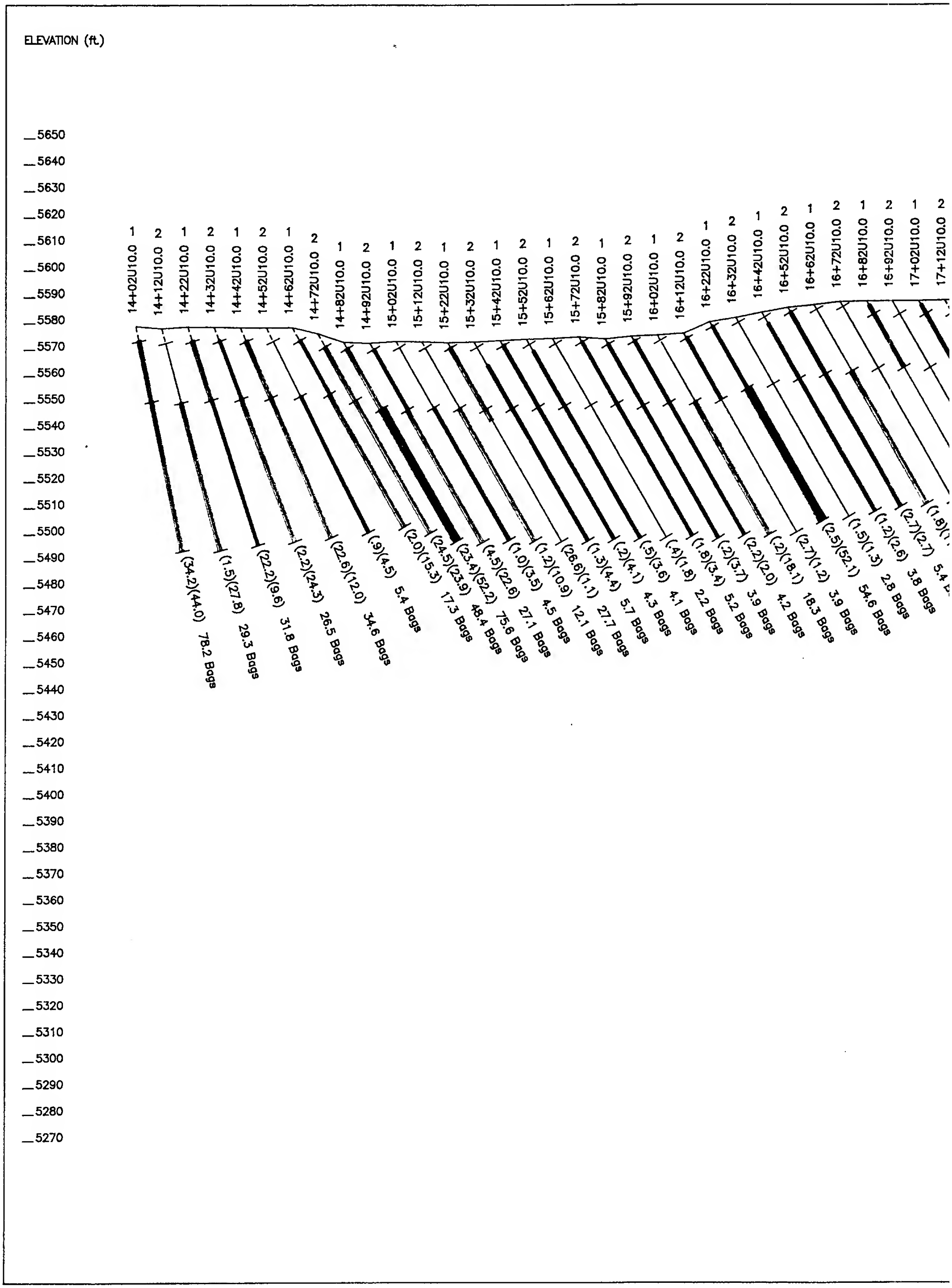
HOLES A1400–A1427

QUATERNARY HOLES

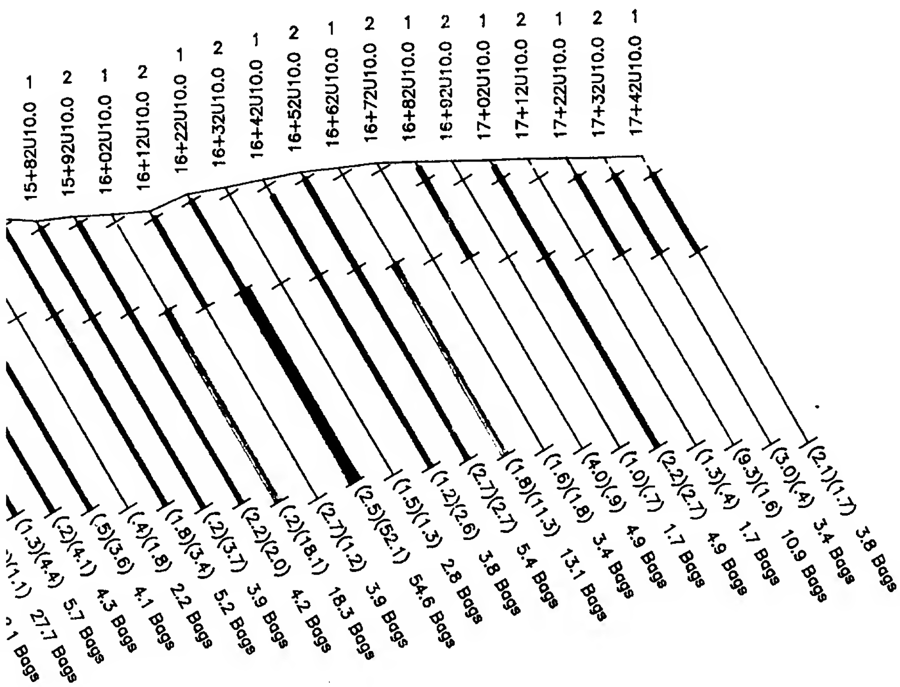
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 57



ELEVATION (ft.)
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
5320
5310
5300
5290
5280
5270
1 14+02U10.0
2 14+12U10.0
1 14+22U10.0
2 14+32U10.0
1 14+42U10.0
2 14+52U10.0
1 14+62U10.0
2 14+72U10.0
1 14+82U10.0
2 14+92U10.0
1 15+02U10.0
2 15+12U10.0
1 15+22U10.0
2 15+32U10.0
1 15+42U10.0
2 15+52U10.0
1 15+62U10.0
2 15+72U10.0
1 15+82U10.0
2 15+92U10.0
1 16+02U10.0
2 16+12U10.0
1 16+22U10.0
2 16+32U10.0
1 16+42U10.0
2 16+52U10.0
1 16+62U10.0
2 16+72U10.0
1 16+82U10.0
2 16+92U10.0
1 17+02U10.0
2 17+12U10.0
(34.2)(44.0) 78.2 Bags
(1.5)(27.8) 29.3 Bags
(22.2)(9.6) 31.8 Bags
(2.2)(24.3) 26.5 Bags
(22.6)(12.0) 34.6 Bags
(.9)(4.5) 5.4 Bags
(2.0)(15.3) 17.3 Bags
(24.5)(23.9) 48.4 Bags
(23.4)(52.2) 75.6 Bags
(4.5)(22.6) 27.1 Bags
(1.0)(3.5) 4.5 Bags
(1.2)(10.9) 12.1 Bags
(26.6)(1.1) 27.7 Bags
(1.3)(4.4) 5.7 Bags
(.2)(4.1) 4.3 Bags
(.5)(3.6) 4.1 Bags
(.4)(1.8) 2.2 Bags
(1.8)(3.4) 5.2 Bags
(.2)(3.7) 3.9 Bags
(2.2)(2.0) 4.2 Bags
(.2)(18.1) 18.3 Bags
(2.7)(1.2) 3.9 Bags
(2.5)(52.1) 54.6 Bags
(1.5)(1.3) 2.8 Bags
(1.2)(2.6) 3.8 Bags
(2.7)(2.7)



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2

Start of STAGE

STAGE take (2 – 10 b

End of STAGE

STAGE take (10 – 50

STAGE take (50 – 100

STAGE take (100+ bags

Depth of hole

150.0 Bags(101.0)(49.0) Total grout tak

0 50

1 Inch = 50

SALT

FOUNDA

HOLE

CORPS

SACRAMENTO

SUBMITTED: Robert L. Tre

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

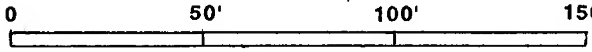
STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags



1 Inch = 50 Feet

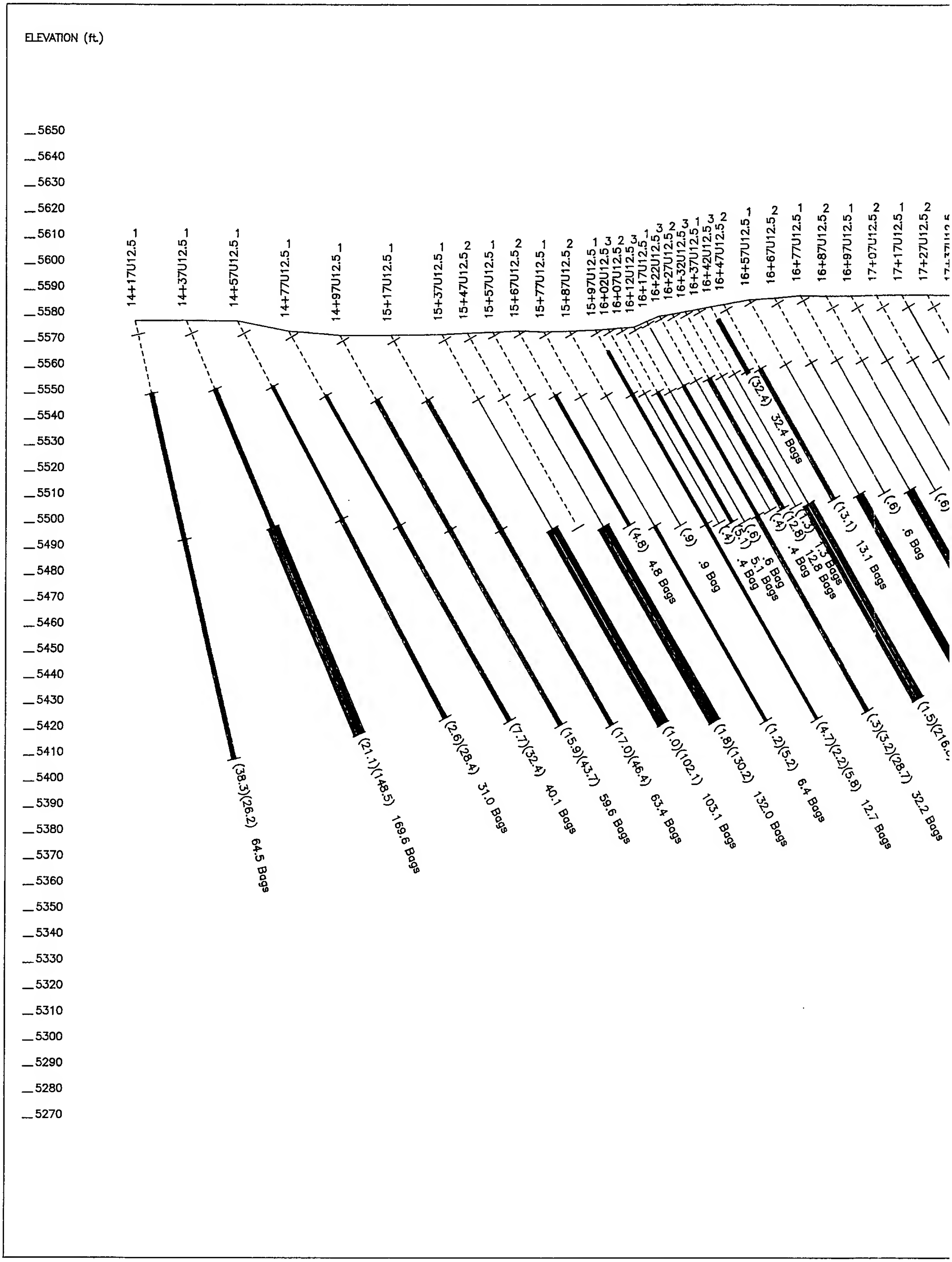
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

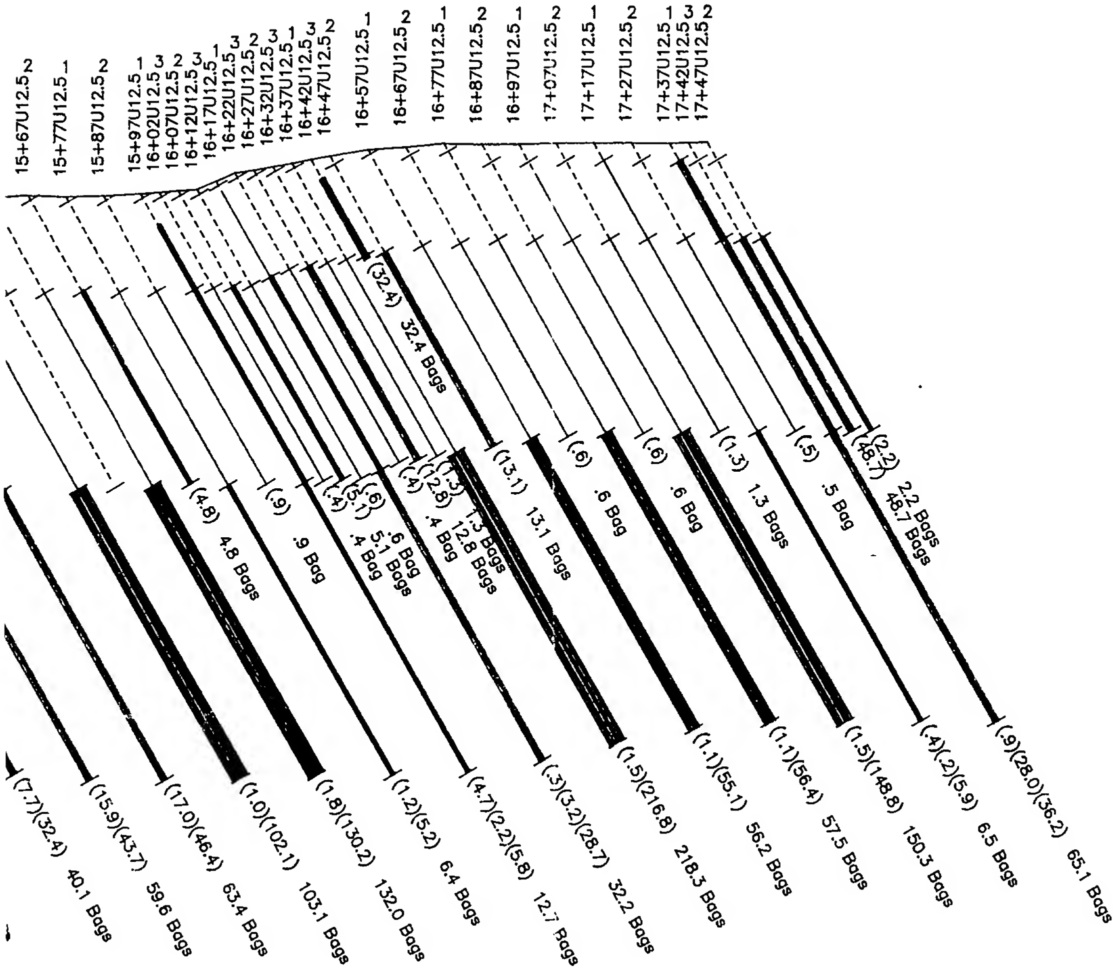
HOLES B1400–B1750

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [illegible] for CARL E. COLE RES. GEOLOGIST			APPROVED: for John [illegible] PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 58



ELEVATION (ft.)
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
5320
5310
5300
5290
5280
5270
14+17U12.5_1
14+37U12.5_1
14+57U12.5_1
14+77U12.5_1
14+97U12.5_1
15+17U12.5_1
15+37U12.5_1
15+47U12.5_2
15+57U12.5_1
15+67U12.5_2
15+77U12.5_1
15+87U12.5_2
15+97U12.5_1
16+02U12.5_3
16+07U12.5_2
16+12U12.5_3
16+17U12.5_1
16+22U12.5_3
16+27U12.5_2
16+32U12.5_3
16+37U12.5_1
16+42U12.5_3
16+47U12.5_2
16+57U12.5_1
16+67U12.5_2
16+77U12.5_1
16+87U12.5_2
16+97U12.5_1
17+07U12.5_2
17+17U12.5_1
17+27U12.5_2
(38.3)(26.2) 64.5 Bags
(21.1)(148.5) 169.6 Bags
(2.6)(28.4) 31.0 Bags
(7.7)(32.4) 40.1 Bags
(15.9)(43.7) 59.6 Bags
(17.0)(46.4) 63.4 Bags
(1.0)(102.1) 103.1 Bags
(1.8)(130.2) 132.0 Bags
(1.2)(5.2) 6.4 Bags
(4.7)(2.2)(5.8) 12.7 Bags
(.3)(3.2)(28.7) 32.2 Bags
(4.8) 4.8 Bags
(.9) .9 Bag
(.4) .4 Bag
(5.1) 5.1 Bags
(.6) .6 Bag
(.4) .4 Bag
(12.8) 12.8 Bags
(1.3) 1.3 Bags
(32.4) 32.4 Bags
(13.1) 13.1 Bags
(.6) .6 Bag
(.6)



LEGEND

1 Primary
2 Secondar
3 Tertiary
4 Quarterna
5 Etc.

5+00U10 1 Category

Hole num

No Data

STAGE tak

Start of S

STAGE tak

End of ST

STAGE tak

STAGE tak

STAGE tak

Depth of

150.0 Bags(101.0)(49.0) Total

0

1 Inch

E

S

SUBMITTED: Ro

for CARL

RES. C

PLOTTED BY:	CH

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 [1] — Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout take in bags

-0)(36.2) 65.1 Bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

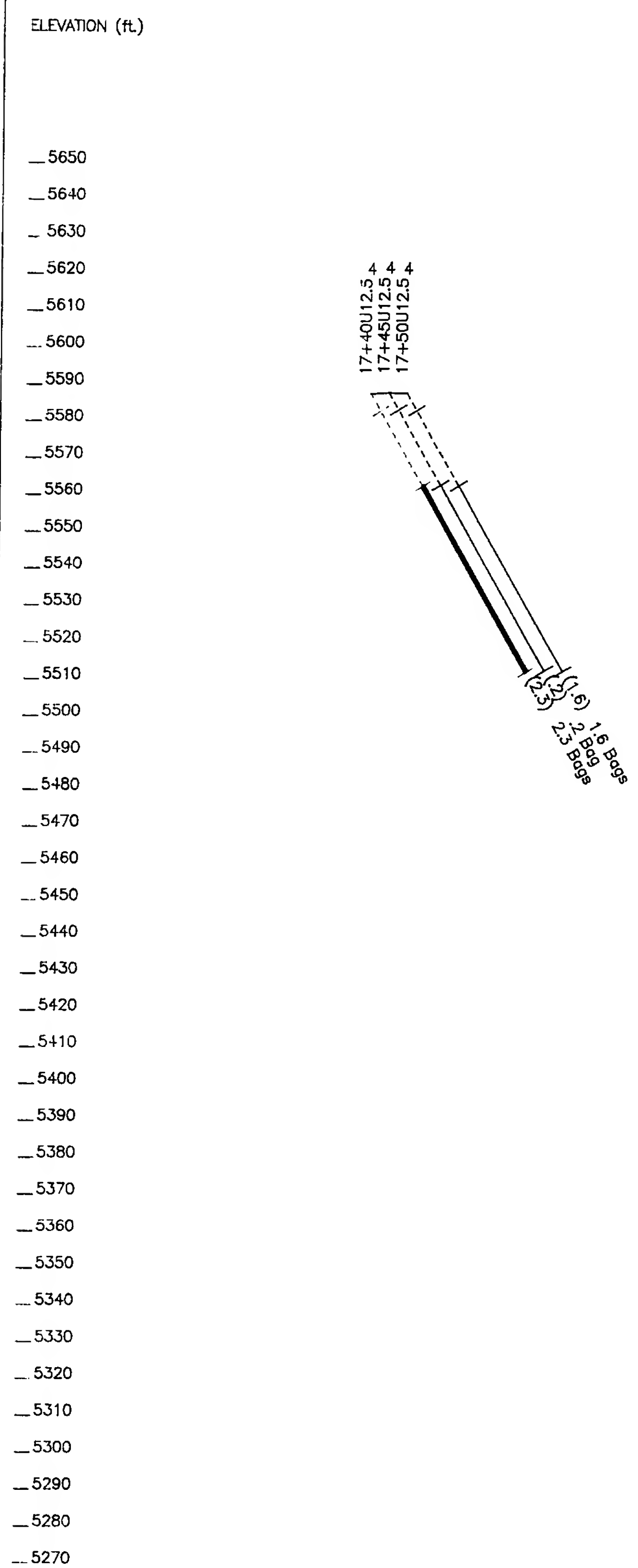
HOLES C1400–C1750

EXCLUDING QUATERNARY HOLES

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat	APPROVED: for John Carriagan
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 59


ELEVATION (ft.)
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
5320
5310
5300
5290
5280
5270
17+40U12.5 4
17+45U12.5 4
17+50U12.5 4
(2.3)
(.2)
(1.6)
1.6 Bags
.2 Bag
2.3 Bags

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

Category (Primary)

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

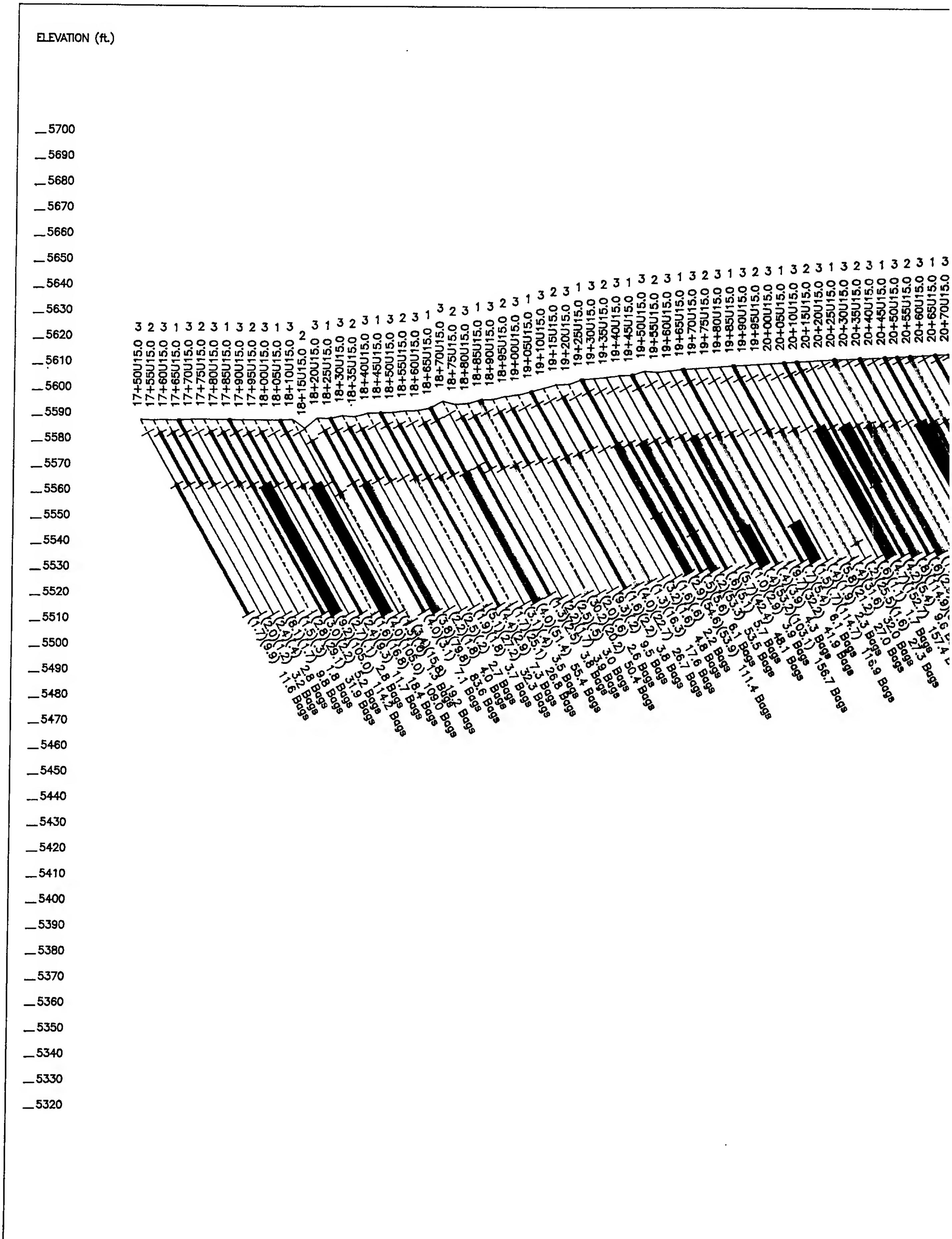
FOUNDATION GROUT CURTAIN

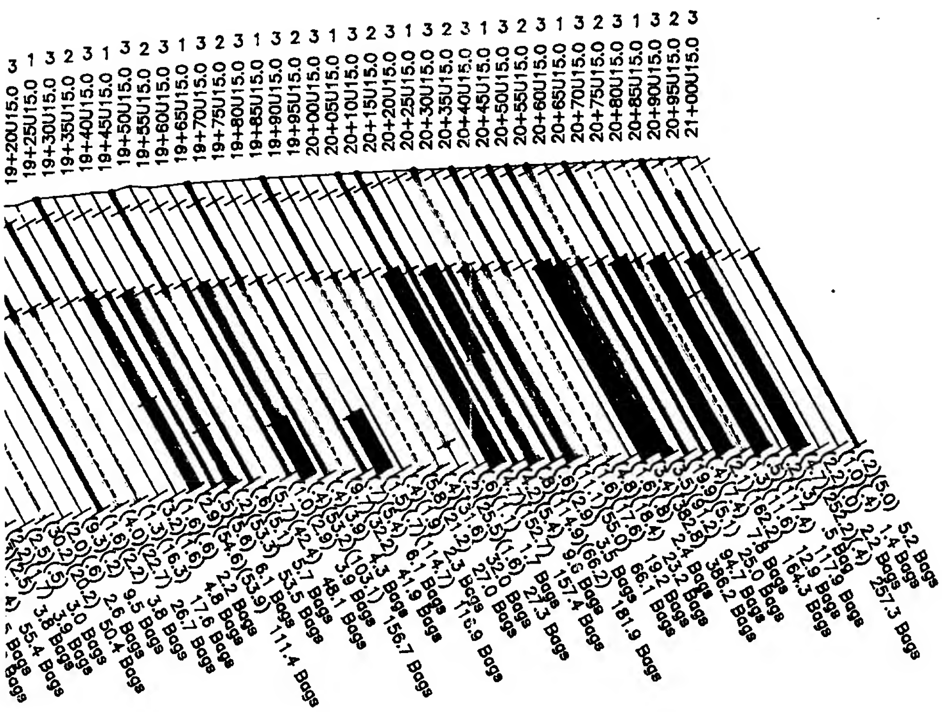
HOLES C1400–C1750

QUATERNARY HOLES

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Trost for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Carnegie PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 60


ELEVATION (ft.)
5700
5690
5680
5670
5660
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
5320
17+50U15.0
17+55U15.0
17+60U15.0
17+65U15.0
17+70U15.0
17+75U15.0
17+80U15.0
17+85U15.0
17+90U15.0
17+95U15.0
18+00U15.0
18+05U15.0
18+10U15.0
18+15U15.0
18+20U15.0
18+25U15.0
18+30U15.0
18+35U15.0
18+40U15.0
18+45U15.0
18+50U15.0
18+55U15.0
18+60U15.0
18+65U15.0
18+70U15.0
18+75U15.0
18+80U15.0
18+85U15.0
18+90U15.0
18+95U15.0
19+00U15.0
19+05U15.0
19+10U15.0
19+15U15.0
19+20U15.0
19+25U15.0
19+30U15.0
19+35U15.0
19+40U15.0
19+45U15.0
19+50U15.0
19+55U15.0
19+60U15.0
19+65U15.0
19+70U15.0
19+75U15.0
19+80U15.0
19+85U15.0
19+90U15.0
19+95U15.0
20+00U15.0
20+05U15.0
20+10U15.0
20+15U15.0
20+20U15.0
20+25U15.0
20+30U15.0
20+35U15.0
20+40U15.0
20+45U15.0
20+50U15.0
20+55U15.0
20+60U15.0
20+65U15.0
20+70U15.0



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less th

Start of STAGE

STAGE take (2 –

End of STAGE

STAGE take (10 –

STAGE take (50 –

STAGE take (100+ b

Depth of hole

Total grout t

150.0 Bags(101.0)(49.0)

0 5

1 Inch = 5(

SAL

FOUND/

HOL

CORF

SACRAMENTC

SUBMITTED: Robert L. Tr

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

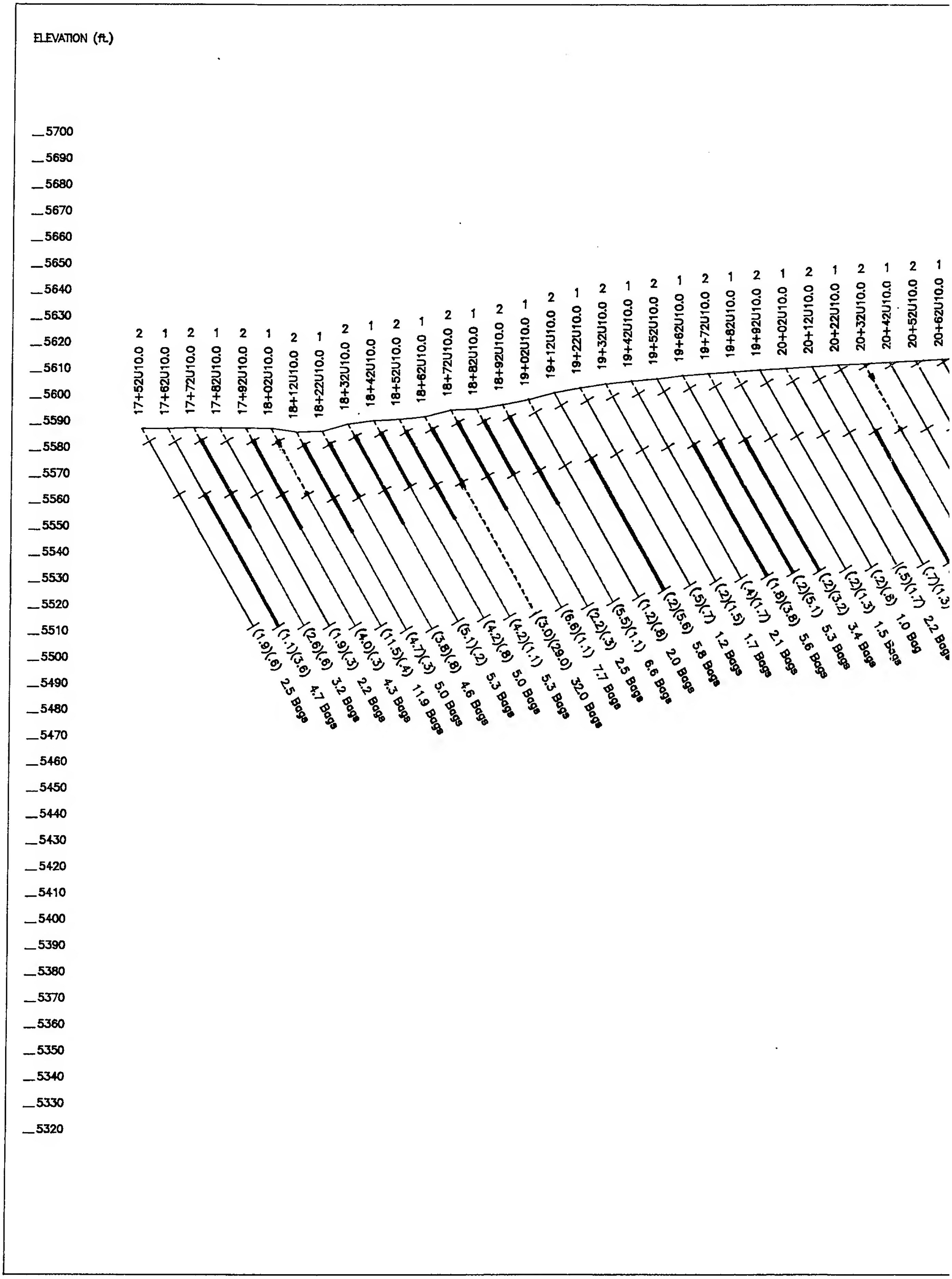
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

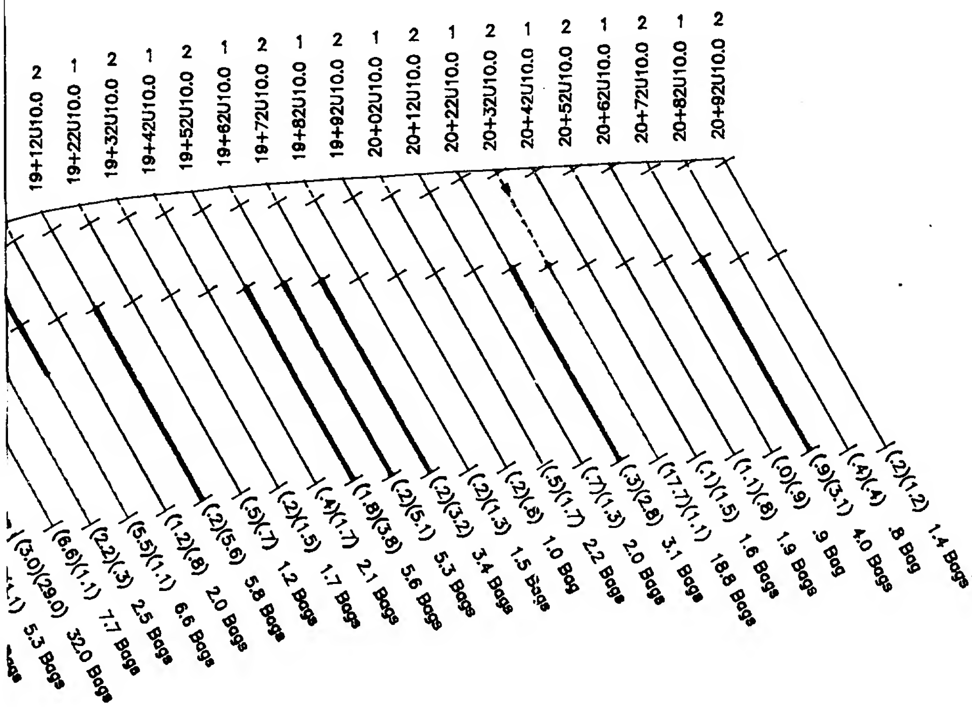
FOUNDATION GROUT CURTAIN

HOLES A1750–A2100

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Carnegie PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 61


ELEVATION (ft.)
5700
5690
5680
5670
5660
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
5320
2 17+52U10.0
1 17+62U10.0
2 17+72U10.0
1 17+82U10.0
2 17+92U10.0
1 18+02U10.0
2 18+12U10.0
1 18+22U10.0
2 18+32U10.0
1 18+42U10.0
2 18+52U10.0
1 18+62U10.0
2 18+72U10.0
1 18+82U10.0
2 18+92U10.0
1 19+02U10.0
2 19+12U10.0
1 19+22U10.0
2 19+32U10.0
1 19+42U10.0
2 19+52U10.0
1 19+62U10.0
2 19+72U10.0
1 19+82U10.0
2 19+92U10.0
1 20+02U10.0
2 20+12U10.0
1 20+22U10.0
2 20+32U10.0
1 20+42U10.0
2 20+52U10.0
1 20+62U10.0
(1.9)(.6) 2.5 Bags
(1.1)(3.6) 4.7 Bags
(2.6)(.6) 3.2 Bags
(1.9)(.3) 2.2 Bags
(4.0)(.3) 4.3 Bags
(11.5)(.4) 11.9 Bags
(4.7)(.3) 5.0 Bags
(3.8)(.8) 4.6 Bags
(5.1)(.2) 5.3 Bags
(4.2)(.8) 5.0 Bags
(4.2)(1.1) 5.3 Bags
(3.0)(29.0) 32.0 Bags
(6.6)(1.1) 7.7 Bags
(2.2)(.3) 2.5 Bags
(5.5)(1.1) 6.6 Bags
(1.2)(.8) 2.0 Bags
(.2)(5.6) 5.8 Bags
(.5)(.7) 1.2 Bags
(.2)(1.5) 1.7 Bags
(.4)(1.7) 2.1 Bags
(1.8)(3.8) 5.6 Bags
(.2)(5.1) 5.3 Bags
(.2)(3.2) 3.4 Bags
(.2)(1.3) 1.5 Bags
(.2)(.8) 1.0 Bag
(.5)(1.7) 2.2 Bags
(.7)(1.3



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Aval

STAGE take (

Start of STAG

STAGE take (

End of STAGE

STAGE take (

STAGE take (

STAGE take (

Depth of hole

150.0 Bags(101.0)(49.0) Total gr

0

1 Inch =

FC

SACF

SUBMITTED: Robert

for CARL E. C

RES. GEOL

PLOTTED BY:	CHECK BY:

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 — Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

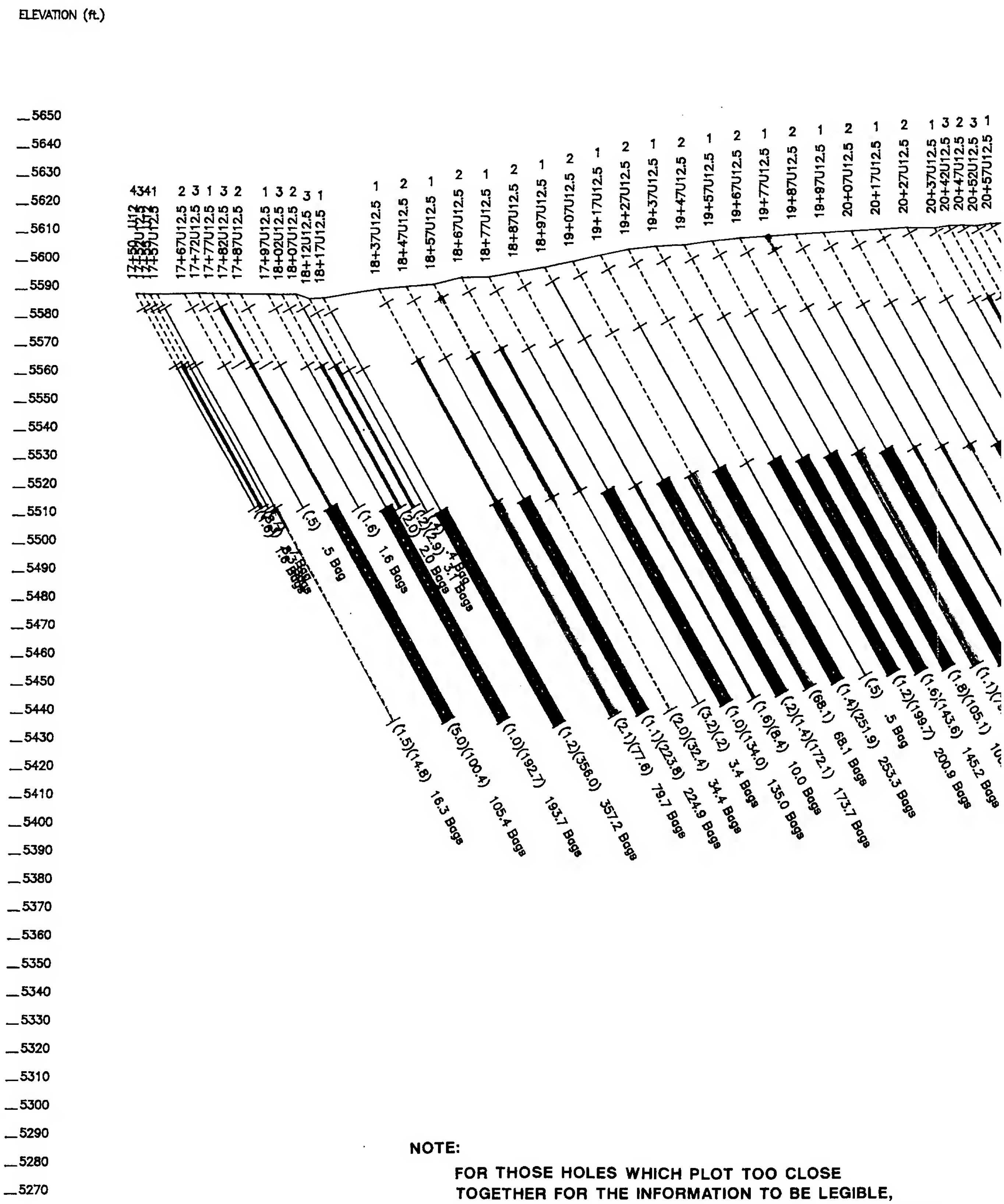
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

HOLES B1750–B2100

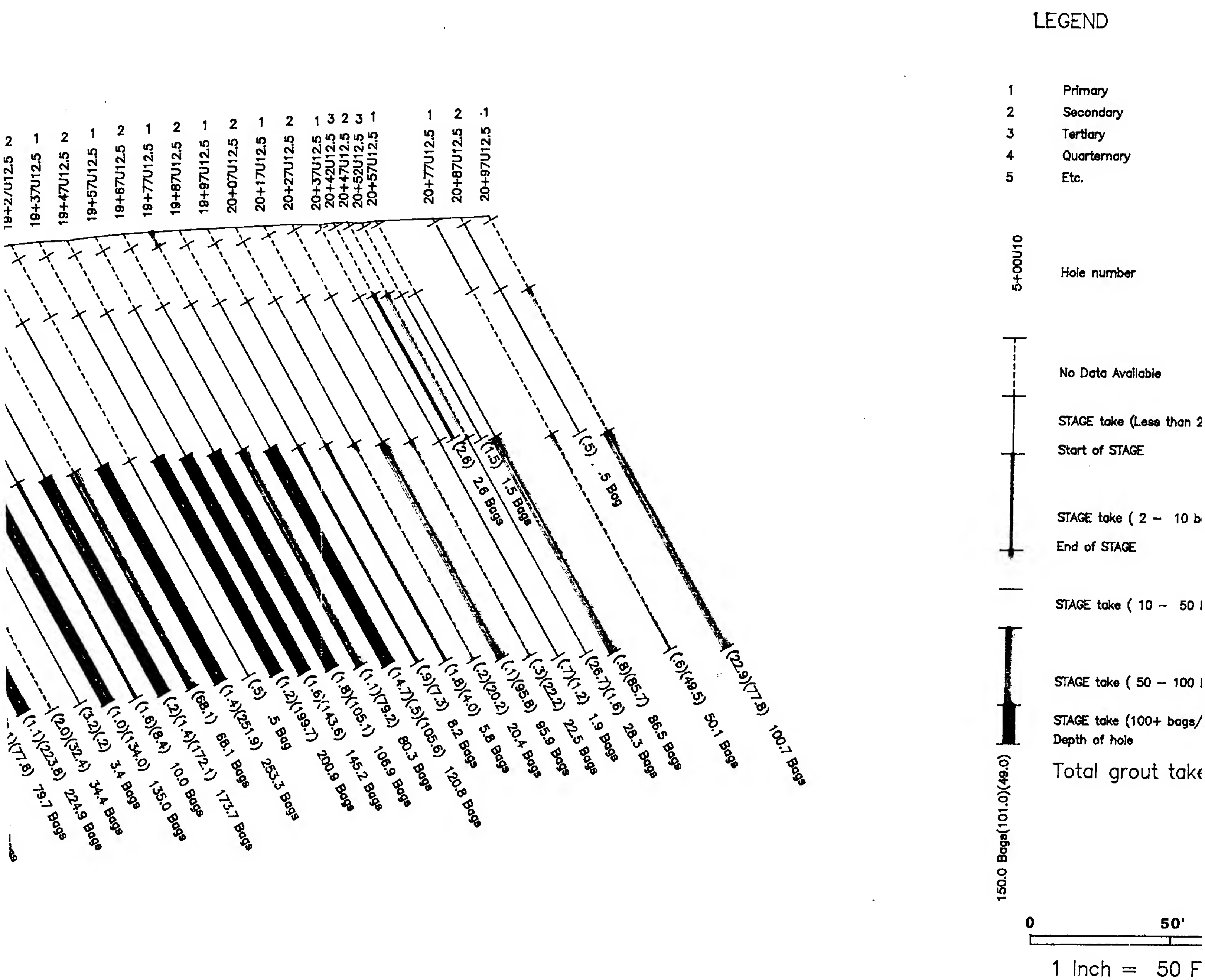
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: for CARL E. COLE, RES. GEOLOGIST			APPROVED: for PAUL M. PARSONEAULT, RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 62



NOTE:

FOR THOSE HOLES WHICH PLOT TOO CLOSE TOGETHER FOR THE INFORMATION TO BE LEGIBLE, PLEASE REFER TO THE APPROPRIATE SECTION OF TABLE 6.



WHICH PLOT TOO CLOSE
INFORMATION TO BE LEGIBLE,
HE APPROPRIATE SECTION OF TABLE 6.

L
SALT LAK
FOUNDATIC
HOLES

CORPS OF
SACRAMENTO DIST

SUBMITTED: Robert L. Trust
for CARL E. COLE
RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEO BY

(22.9)(77.8) 100.7 Bags

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

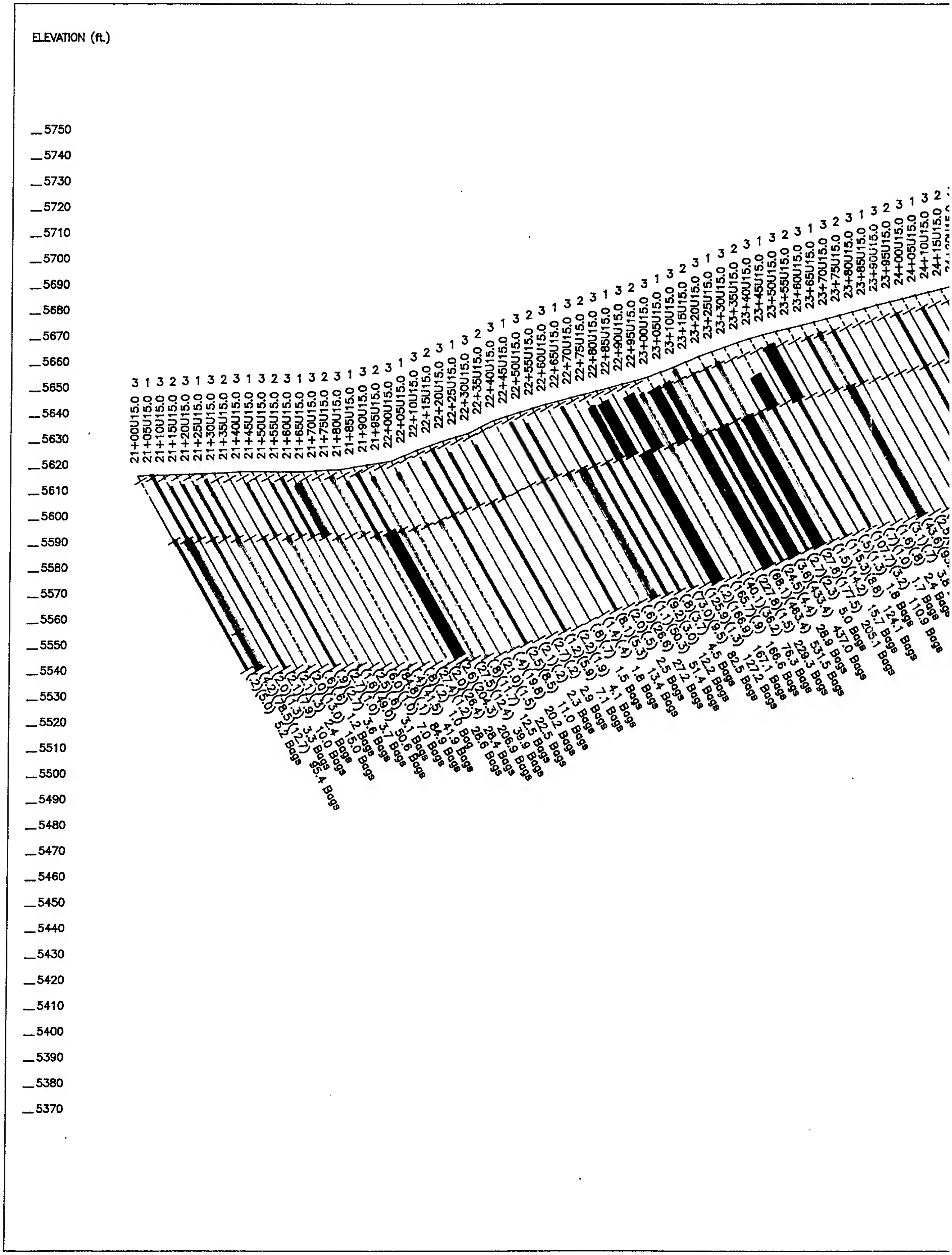
FOUNDATION GROUT CURTAIN

HOLES C1750–C2100

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [illegible] for CARL E. COLE RES. GEOLOGIST	APPROVED: for [illegible] PAUL M. PARSONEAULT RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 63



ELEVATION (ft.)
5750
5740
5730
5720
5710
5700
5690
5680
5670
5660
5650
5640
5630
5620
5610
5600
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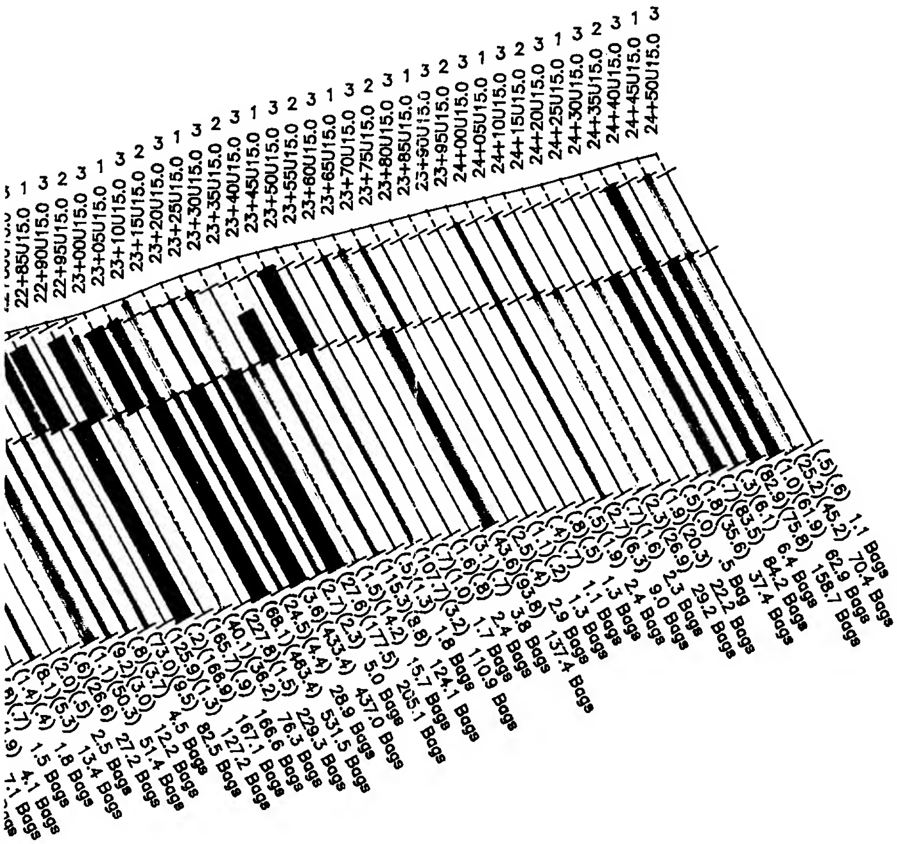
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2

Start of STAGE

STAGE take (2 – 10 bag

End of STAGE

STAGE take (10 – 50 ba

STAGE take (50 – 100 ba

STAGE take (100+ bags/ST

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take

0 50'

1 Inch = 50 Fe

LITT

SALT LAKE

FOUNDATION

HOLES A

CORPS OF E

SACRAMENTO DISTRIC

SUBMITTED: Robert L. Frost

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 — Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

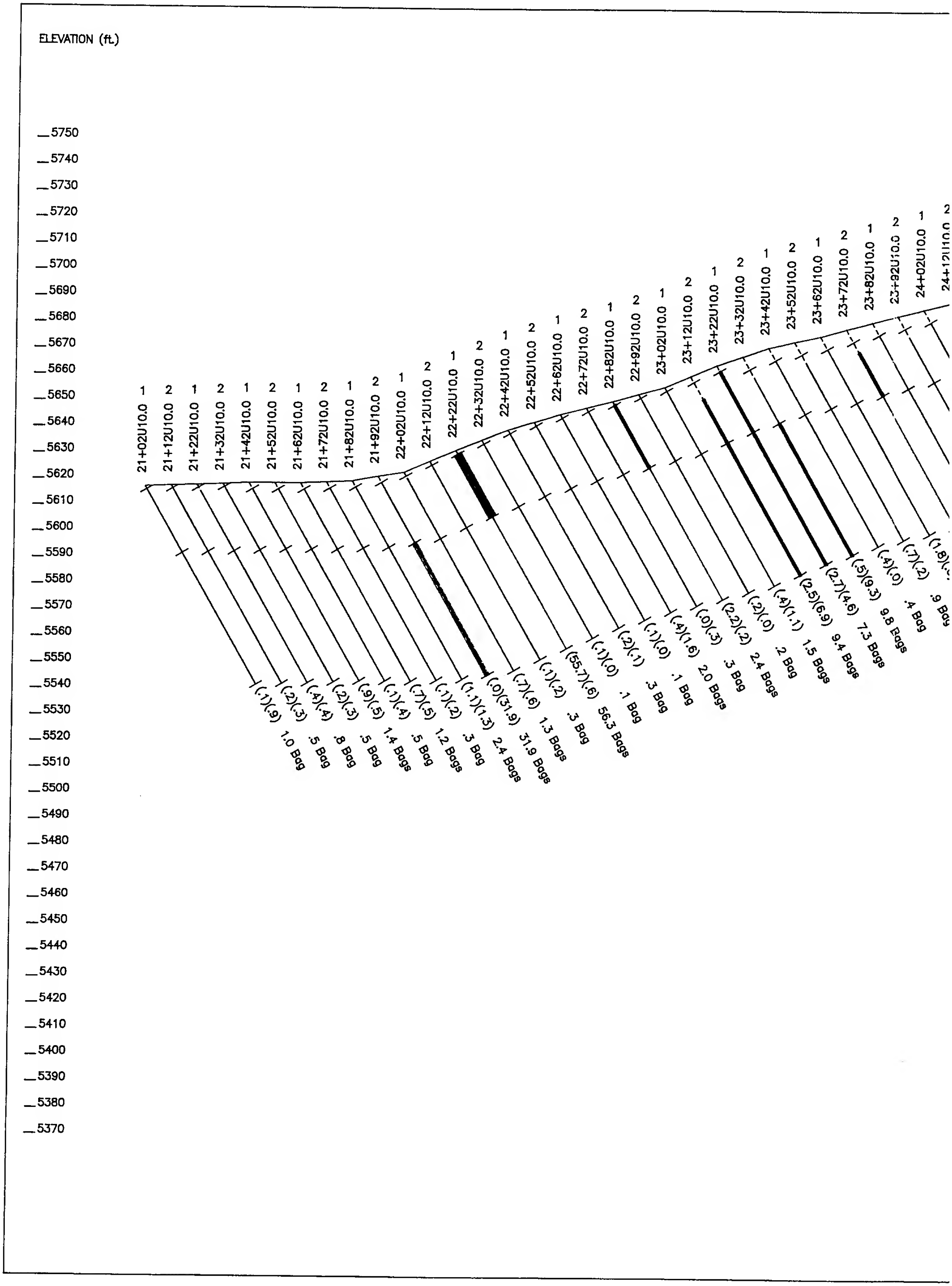
FOUNDATION GROUT CURTAIN

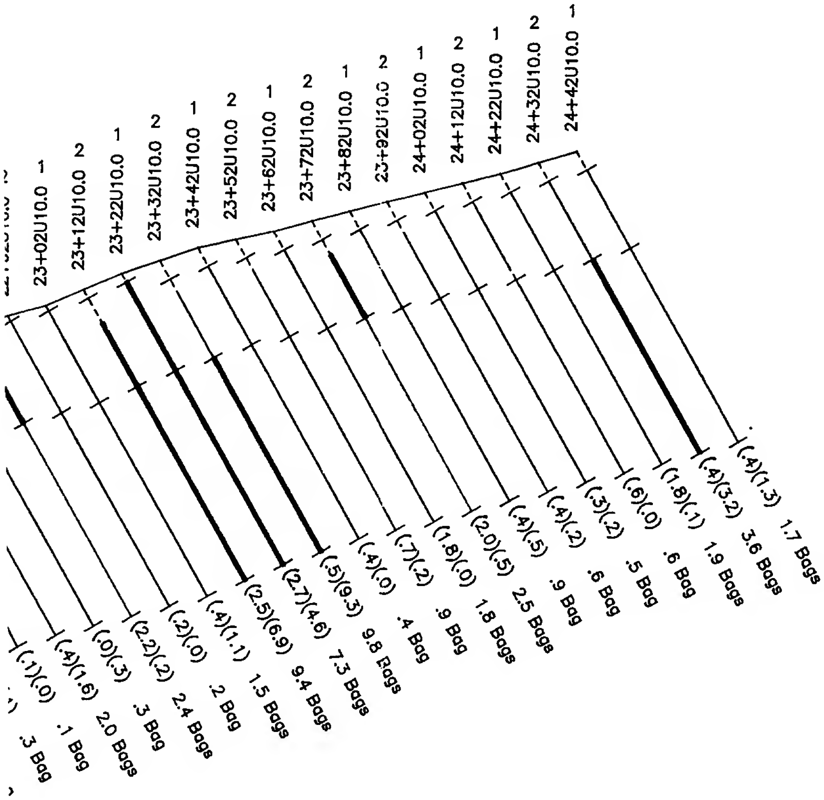
HOLES A2100–A2450

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO.
			PLATE 64


ELEVATION (ft.)
5750
5740
5730
5720
5710
5700
5690
5680
5670
5660
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
21+02U10.0
21+12U10.0
21+22U10.0
21+32U10.0
21+42U10.0
21+52U10.0
21+62U10.0
21+72U10.0
21+82U10.0
21+92U10.0
22+02U10.0
22+12U10.0
22+22U10.0
22+32U10.0
22+42U10.0
22+52U10.0
22+62U10.0
22+72U10.0
22+82U10.0
22+92U10.0
23+02U10.0
23+12U10.0
23+22U10.0
23+32U10.0
23+42U10.0
23+52U10.0
23+62U10.0
23+72U10.0
23+82U10.0
23+92U10.0
24+02U10.0
(.1)(.9) 1.0 Bag
(.2)(.3) .5 Bag
(.4)(.4) .8 Bag
(.2)(.3) .5 Bag
(.9)(.5) 1.4 Bags
(.1)(.4) .5 Bag
(.7)(.5) 1.2 Bags
(.1)(.2) .3 Bag
(1.1)(1.3) 2.4 Bags
(.0)(31.9) 31.9 Bags
(.7)(.6) 1.3 Bags
(.1)(.2) .3 Bag
(55.7)(.6) 56.3 Bags
(.1)(.0) .1 Bag
(.2)(.1) .3 Bag
(.1)(.0) .1 Bag
(.4)(1.6) 2.0 Bags
(.0)(.3) .3 Bag
(2.2)(.2) 2.4 Bags
(.2)(.0) .2 Bag
(.4)(1.1) 1.5 Bags
(2.5)(6.9) 9.4 Bags
(2.7)(4.6) 7.3 Bags
(.5)(9.3) 9.8 Bags
(.4)(.0) .4 Bag
(.7)(.2) .9 Bag



LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bag

Start of STAGE

STAGE take (2 – 10 bags/S

End of STAGE

STAGE take (10 – 50 bags/

STAGE take (50 – 100 bags/

STAGE take (100+ bags/STAGE

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in

0 50'

1 Inch = 50 Feet

LITTLE

SALT LAKE CI

FOUNDATION

HOLES B2

CORPS OF ENG

SACRAMENTO DISTRICT,

SUBMITTED: Robert L. Frost

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

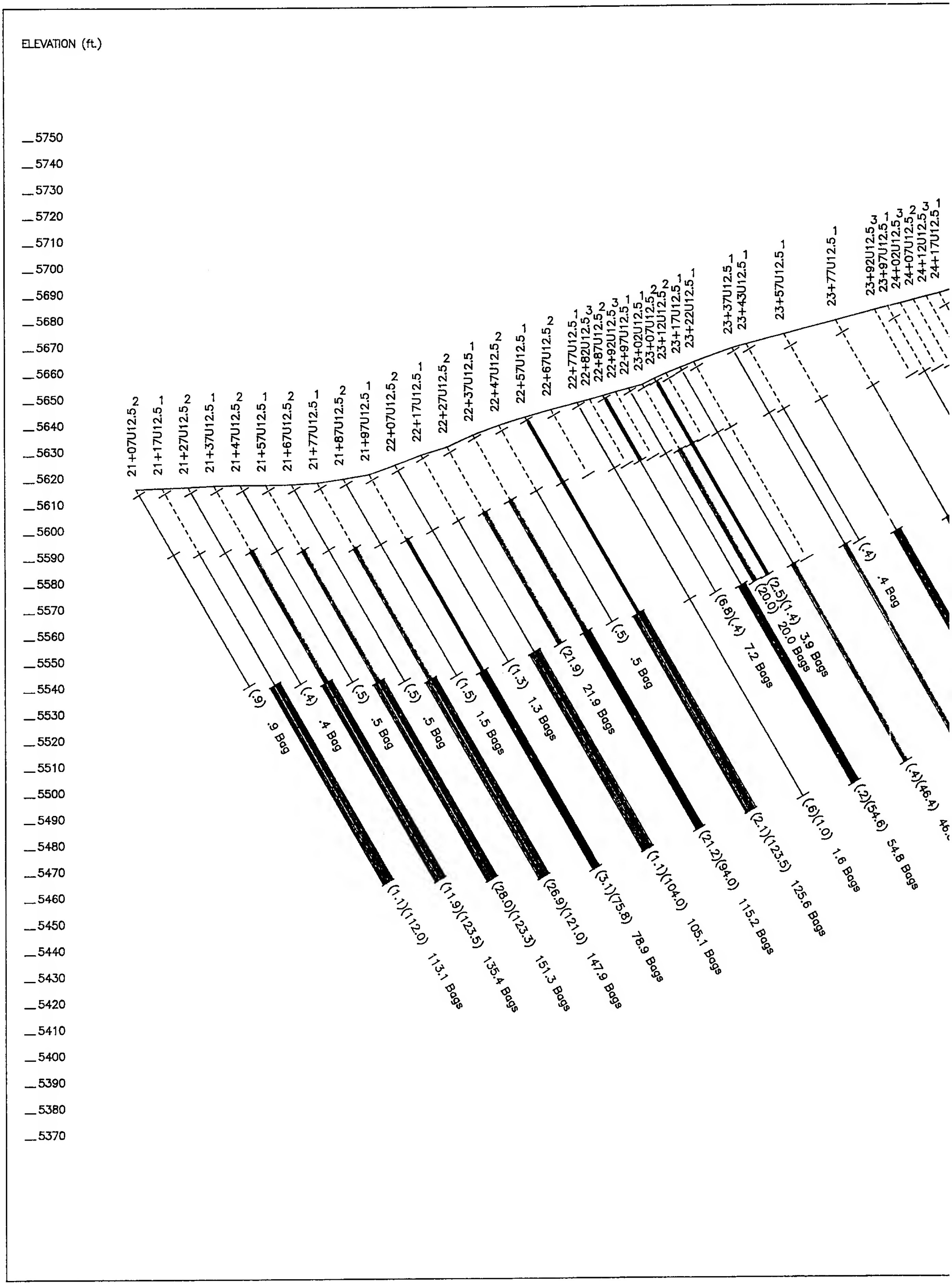
FOUNDATION GROUT CURTAIN

HOLES B2100–B2450

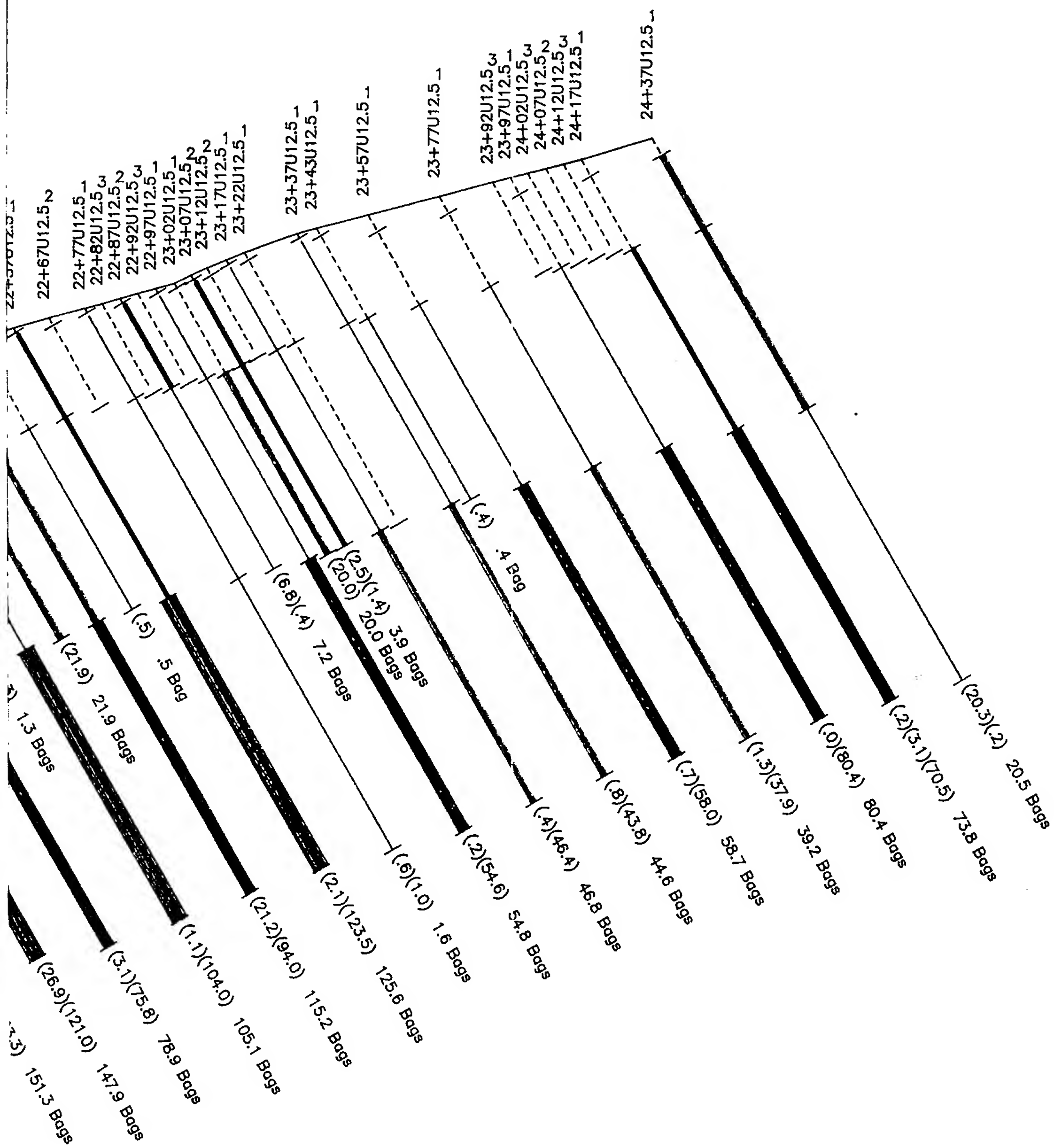
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 65



ELEVATION (ft.)
5750
5740
5730
5720
5710
5700
5690
5680
5670
5660
5650
5640
5630
5620
5610
5600
5590
5580
5570
5560
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
5380
5370
21+07U12.5 2
21+17U12.5 1
21+27U12.5 2
21+37U12.5 1
21+47U12.5 2
21+57U12.5 1
21+67U12.5 2
21+77U12.5 1
21+87U12.5 2
21+97U12.5 1
22+07U12.5 2
22+17U12.5 1
22+27U12.5 2
22+37U12.5 1
22+47U12.5 2
22+57U12.5 1
22+67U12.5 2
22+77U12.5 1
22+82U12.5 3
22+87U12.5 2
22+92U12.5 3
22+97U12.5 1
23+02U12.5 1
23+07U12.5 2
23+12U12.5 2
23+17U12.5 1
23+22U12.5 1
23+37U12.5 1
23+43U12.5 1
23+57U12.5 1
23+77U12.5 1
23+92U12.5 3
23+97U12.5 1
24+02U12.5 3
24+07U12.5 2
24+12U12.5 3
24+17U12.5 1
(.9) .9 Bag
(.4) .4 Bag
(.5) .5 Bag
(.5) .5 Bag
(1.5) 1.5 Bags
(1.3) 1.3 Bags
(21.9) 21.9 Bags
(.5) .5 Bag
(6.8)(.4) 7.2 Bags
(2.5)(1.4) 3.9 Bags
(20.0) 20.0 Bags
(.4) .4 Bag
(1.1)(112.0) 113.1 Bags
(11.9)(123.5) 135.4 Bags
(28.0)(123.3) 151.3 Bags
(26.9)(121.0) 147.9 Bags
(3.1)(75.8) 78.9 Bags
(1.1)(104.0) 105.1 Bags
(21.2)(94.0) 115.2 Bags
(2.1)(123.5) 125.6 Bags
(.6)(1.0) 1.6 Bags
(.2)(54.6) 54.8 Bags
(.4)(46.4)



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

Category (P

Hole numbe

No Data Ava

STAGE take

Start of STA

STAGE take

End of STAG

STAGE take

STAGE take

STAGE take

Depth of ho

Total gr

0

1 Inch

F

SA

SUBMITTED: Robe

for CARL E.

RES. GE

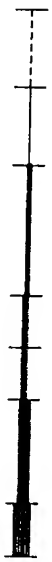
PLOTTED BY:	CHEC BY

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10[1] Category (Primary)

Hole number



No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

.5 Bags

0 50' 100' 150'

1 Inch = 50 Feet

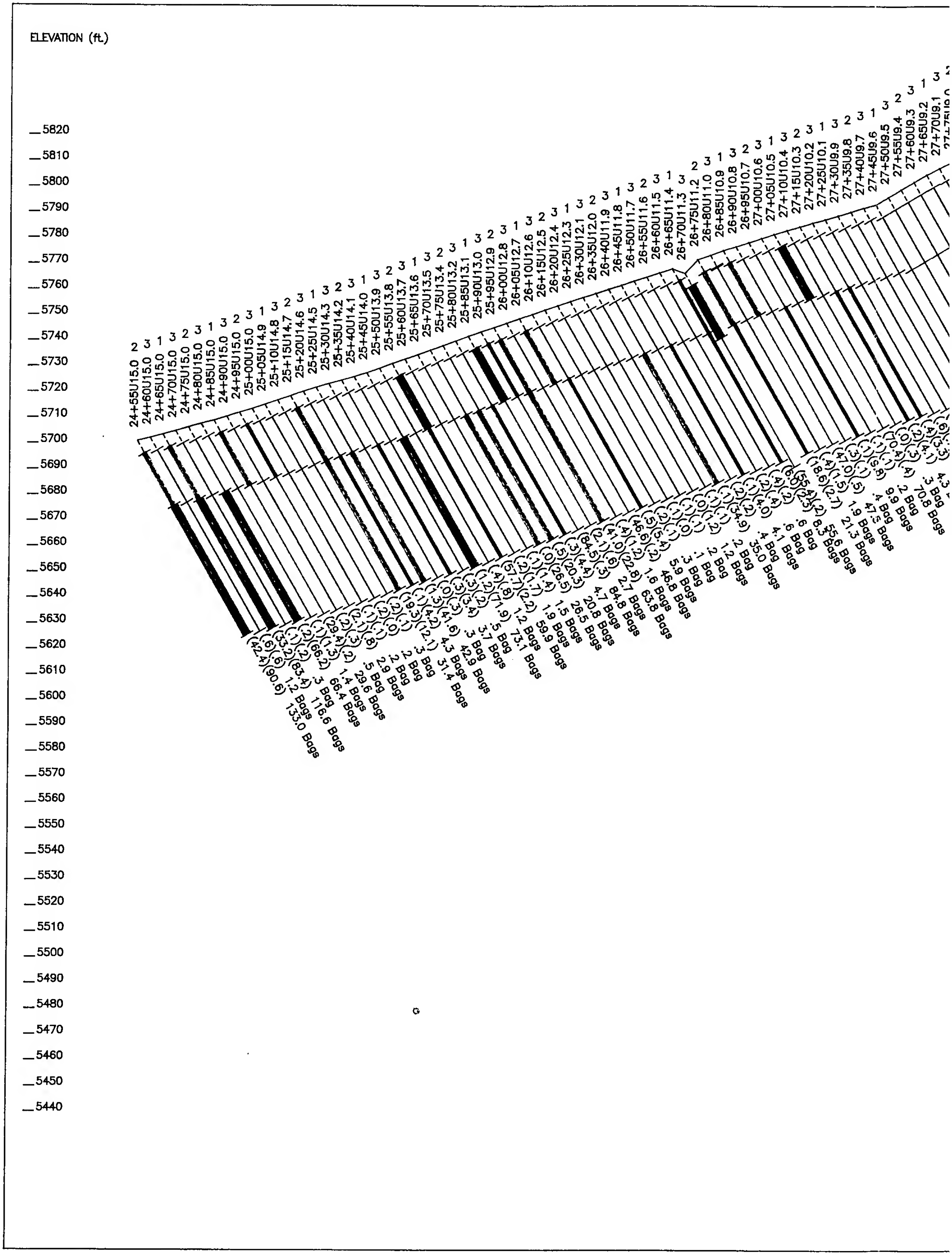
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

HOLES C2100–C2450

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: for PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 66


ELEVATION (ft.)
5820
5810
5800
5790
5780
5770
5760
5750
5740
5730
5720
5710
5700
5690
5680
5670
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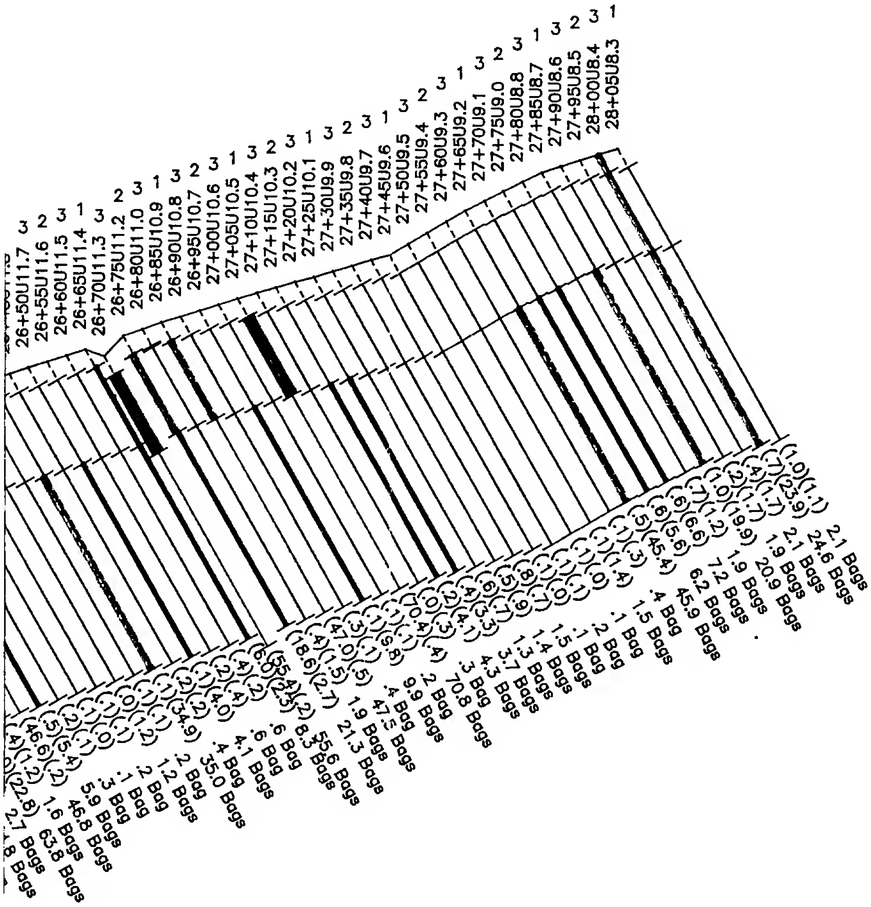
5470
5460
5450
5440



LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

Hole number

No Data Available

STAGE take (Less than 2 Bags/

Start of STAGE

STAGE take (2 – 10 bags/ST

End of STAGE

STAGE take (10 – 50 bags/S

STAGE take (50 – 100 bags/S

STAGE take (100+ bags/STAGE)

Depth of hole

Total grout take in

0 50'

1 Inch = 50 Feet

LITTLE I

SALT LAKE CIT

FOUNDATION (

HOLES A2-

CORPS OF ENGI

SACRAMENTO DISTRICT,

SUBMITTED: Robert L. Frost

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:

LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 — Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) — Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

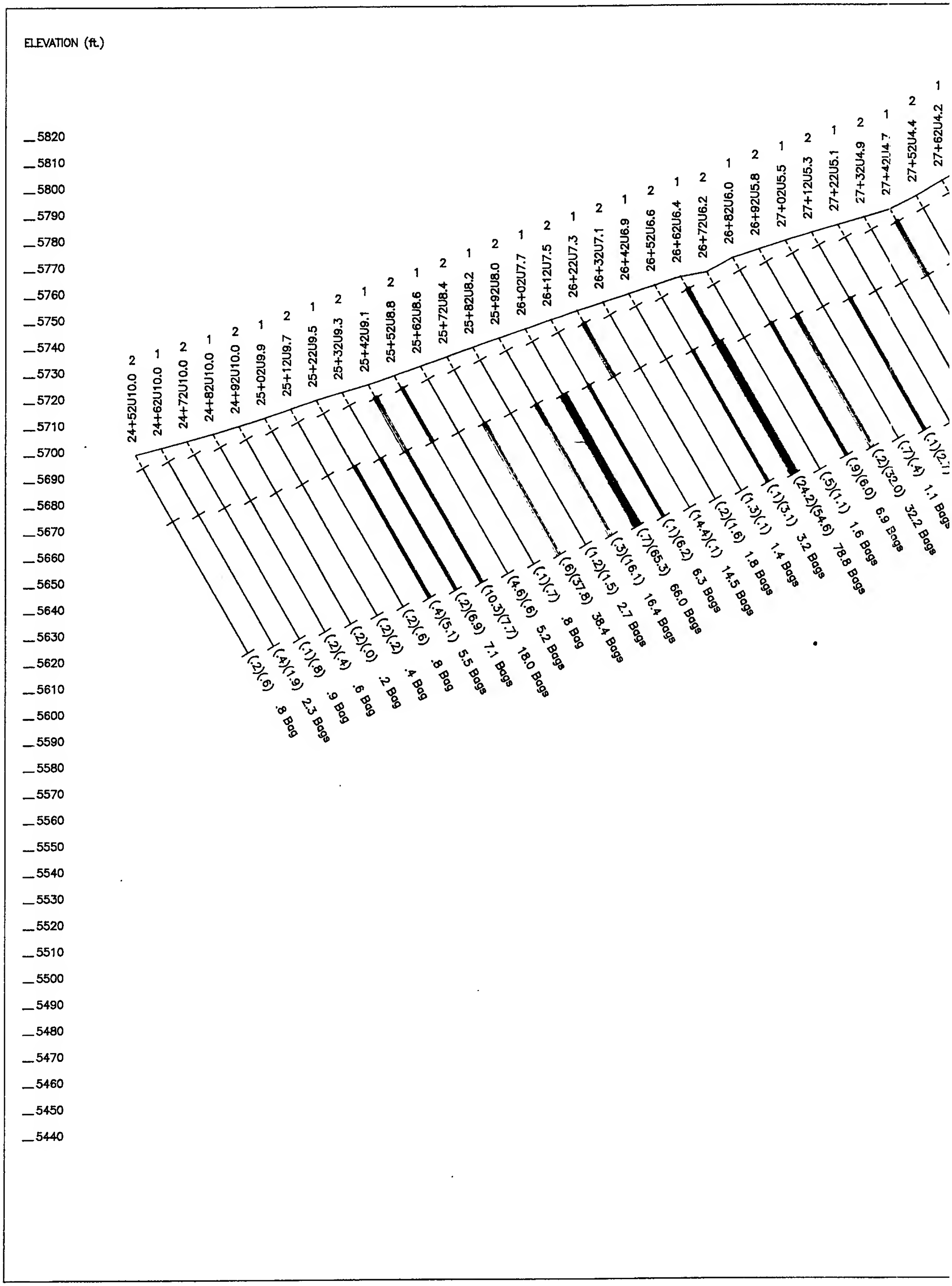
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

HOLES A2450–A2817

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [illegible] for CARL E. COLE, RES. GEOLOGIST			APPROVED: for John [illegible] PAUL M. PARSONEAULT, RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 67


ELEVATION (ft.)
5820
5810
5800
5790
5780
5770
5760
5750
5740
5730
5720
5710
5700
5690
5680
5670
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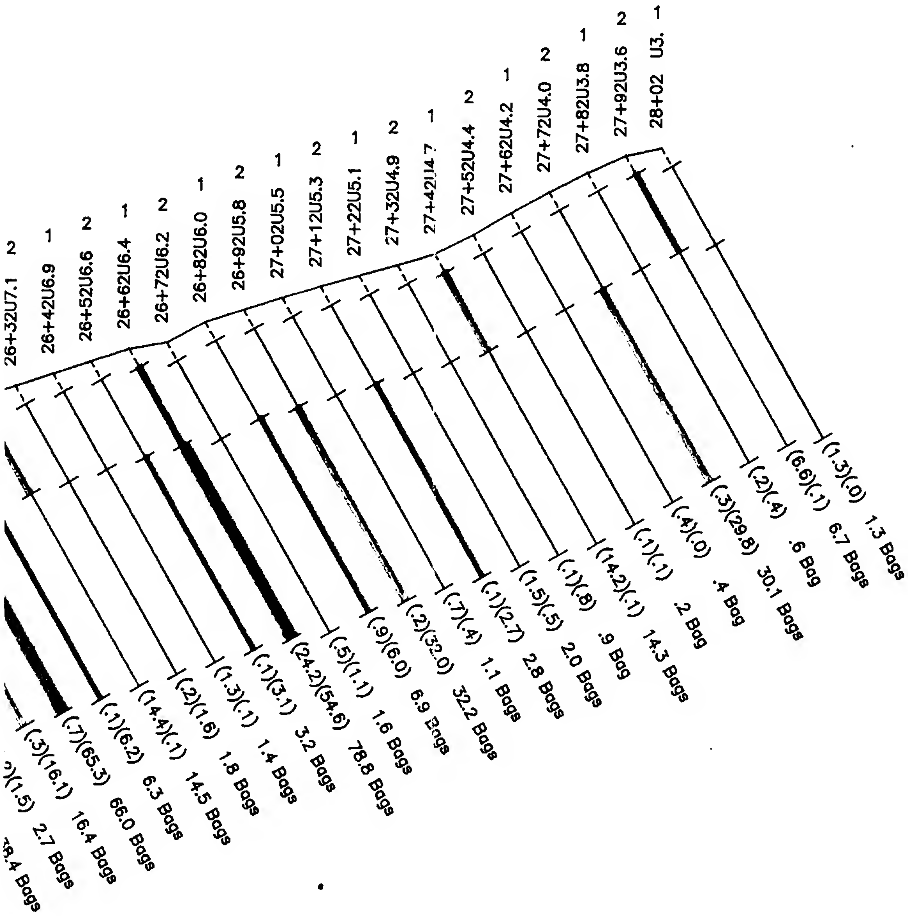
5550
5540
5530
5520
5510
5500
5490
5480
5470
5460
5450
5440
2 24+52U10.0
1 24+62U10.0
2 24+72U10.0
1 24+82U10.0
2 24+92U10.0
1 25+02U9.9
2 25+12U9.7
1 25+22U9.5
2 25+32U9.3
1 25+42U9.1
2 25+52U8.8
1 25+62U8.6
2 25+72U8.4
1 25+82U8.2
2 25+92U8.0
1 26+02U7.7
2 26+12U7.5
1 26+22U7.3
2 26+32U7.1
1 26+42U6.9
2 26+52U6.6
1 26+62U6.4
2 26+72U6.2
1 26+82U6.0
2 26+92U5.8
1 27+02U5.5
2 27+12U5.3
1 27+22U5.1
2 27+32U4.9
1 27+42U4.7
2 27+52U4.4
1 27+62U4.2
(.2)(.6) .8 Bag
(.4)(1.9) 2.3 Bags
(.1)(.8) .9 Bag
(.2)(.4) .6 Bag
(.2)(.0) .2 Bag
(.2)(.2) .4 Bag
(.2)(.6) .8 Bag
(.4)(5.1) 5.5 Bags
(.2)(6.9) 7.1 Bags
(10.3)(7.7) 18.0 Bags
(4.6)(.6) 5.2 Bags
(.1)(.7) .8 Bag
(.6)(37.8) 38.4 Bags
(1.2)(1.5) 2.7 Bags
(.3)(16.1) 16.4 Bags
(.7)(65.3) 66.0 Bags
(.1)(6.2) 6.3 Bags
(14.4)(.1) 14.5 Bags
(.2)(1.6) 1.8 Bags
(1.3)(.1) 1.4 Bags
(.1)(3.1) 3.2 Bags
(24.2)(54.6) 78.8 Bags
(.5)(1.1) 1.6 Bags
(.9)(6.0) 6.9 Bags
(.2)(32.0) 32.2 Bags
(.7)(.4) 1.1 Bags



LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2

Start of STAGE

STAGE take (2 – 10 b

End of STAGE

STAGE take (10 – 50

STAGE take (50 – 100

STAGE take (100+ bags/

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take

0 50'

1 Inch = 50 F

SALT LA

FOUNDATI

HOLES

CORPS O

SACRAMENTO DIS

SUBMITTED: Robert L. Frost

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GE BY

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

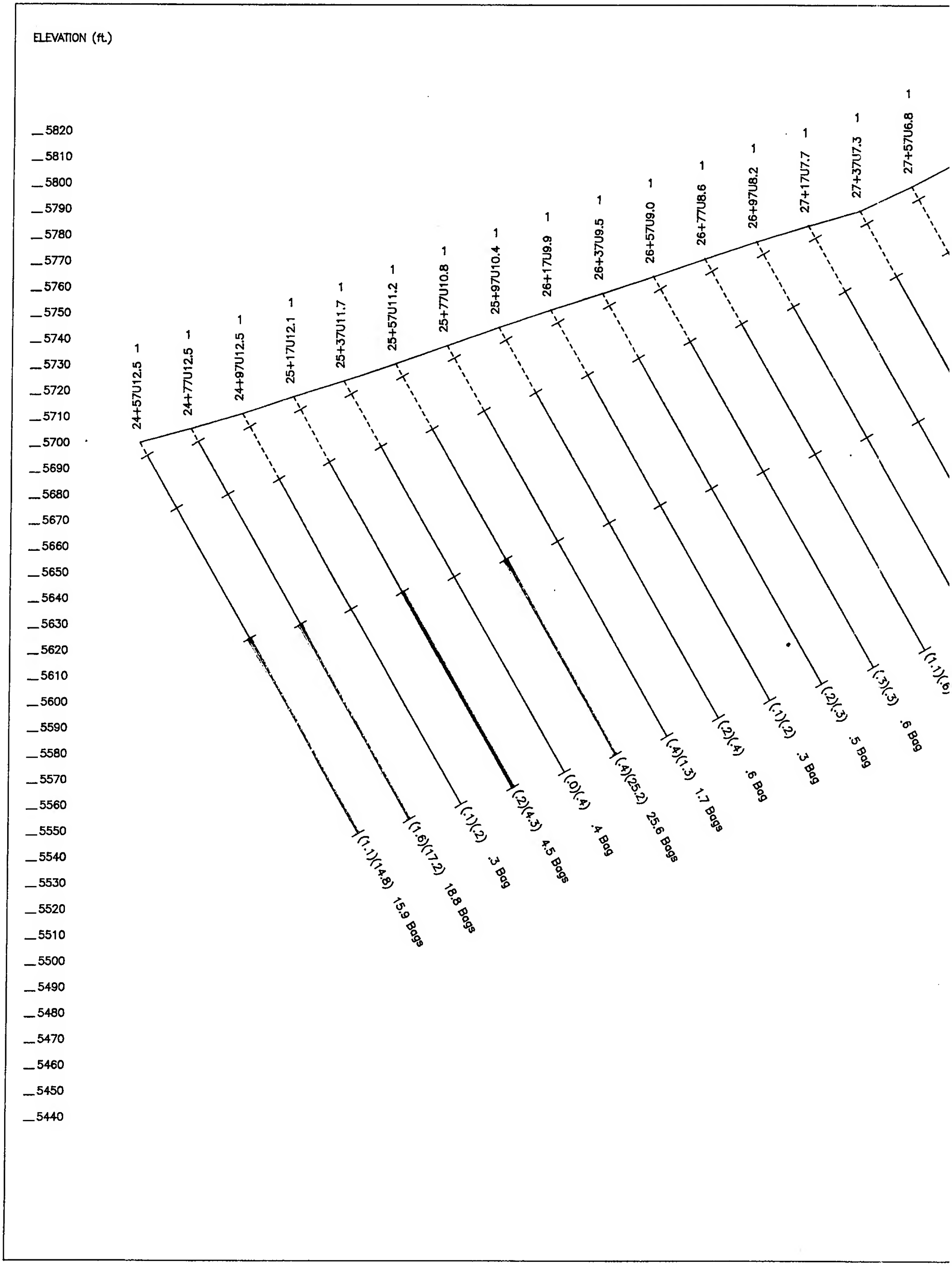
FOUNDATION GROUT CURTAIN

HOLES B2450–B2817

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost	APPROVED:
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 68


ELEVATION (ft.)
5820
5810
5800
5790
5780
5770
5760
5750
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5710
5700
5690
5680
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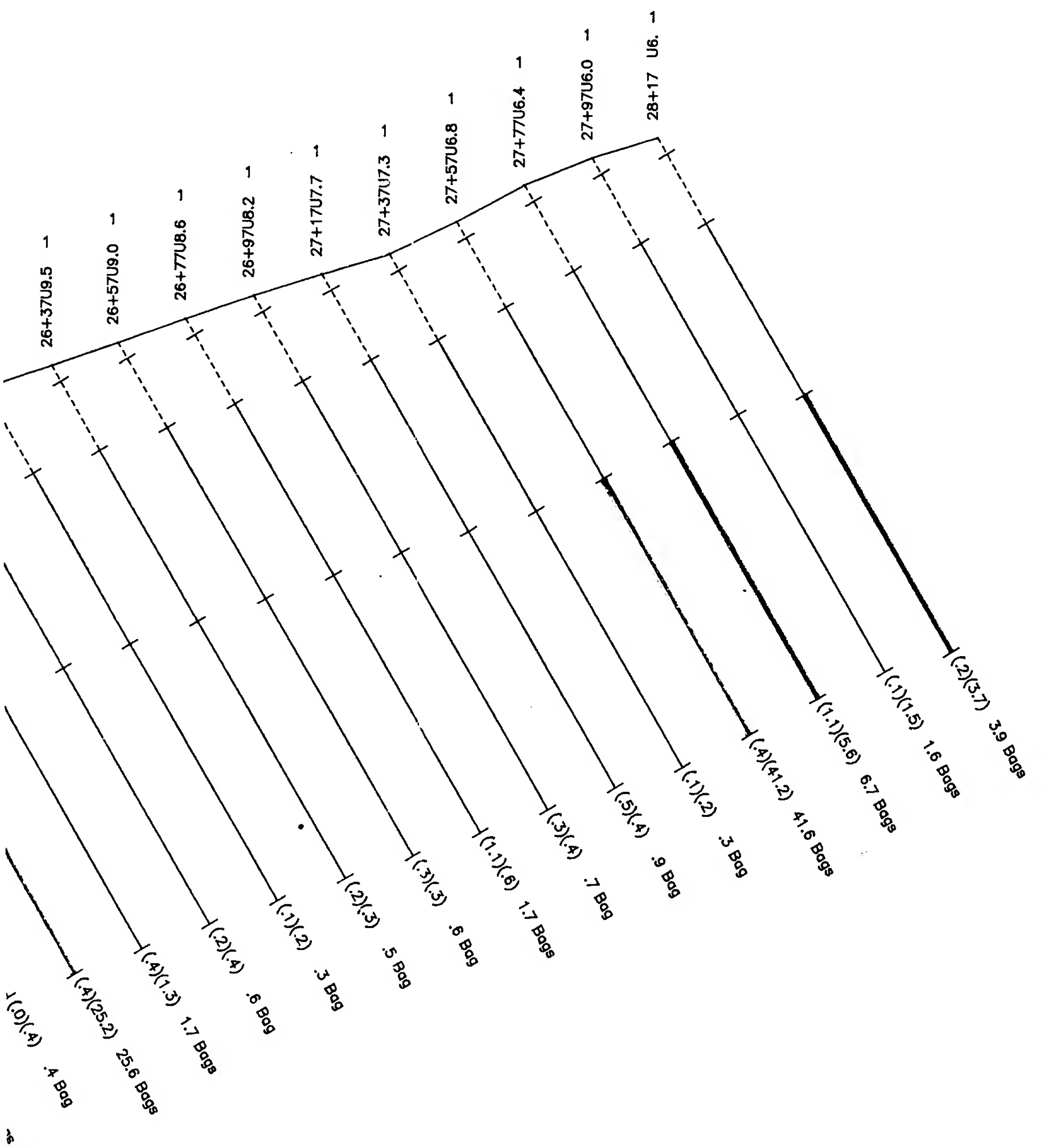
5510
5500
5490
5480
5470
5460
5450
5440
24+57U12.5 1
24+77U12.5 1
24+97U12.5 1
25+17U12.1 1
25+37U11.7 1
25+57U11.2 1
25+77U10.8 1
25+97U10.4 1
26+17U9.9 1
26+37U9.5 1
26+57U9.0 1
26+77U8.6 1
26+97U8.2 1
27+17U7.7 1
27+37U7.3 1
27+57U6.8 1
(1.1)(14.8) 15.9 Bags
(1.6)(17.2) 18.8 Bags
(.1)(.2) .3 Bag
(.2)(4.3) 4.5 Bags
(.0)(.4) .4 Bag
(.4)(25.2) 25.6 Bags
(.4)(1.3) 1.7 Bags
(.2)(.4) .6 Bag
(.1)(.2) .3 Bag
(.2)(.3) .5 Bag
(.3)(.3) .6 Bag
(1.1)(.6)



LEGEND

1	Primary
2	Secondary
3	Tertiary
4	Quarternary
5	Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less th

Start of STAGE

STAGE take (2 –

End of STAGE

STAGE take (10 –

STAGE take (50 –

STAGE take (100+ b

Depth of hole

Total grout t

150.0 Bags(101.0)(49.0)

0

1 Inch = 5

SA

FOUND

HO

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SACRAMENT

SUBMITTED: Robert L. J

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:

LEGEND

1 Primary
2 Secondary
3 Tertiary
4 Quarternary
5 Etc.

5+00U10 Hole number

No Data Available

STAGE take (Less than 2 Bags/STAGE)

Start of STAGE

STAGE take (2 – 10 bags/STAGE)

End of STAGE

STAGE take (10 – 50 bags/STAGE)

STAGE take (50 – 100 bags/STAGE)

STAGE take (100+ bags/STAGE)

Depth of hole

150.0 Bags(101.0)(49.0) Total grout take in bags

0 50' 100' 150'

1 Inch = 50 Feet

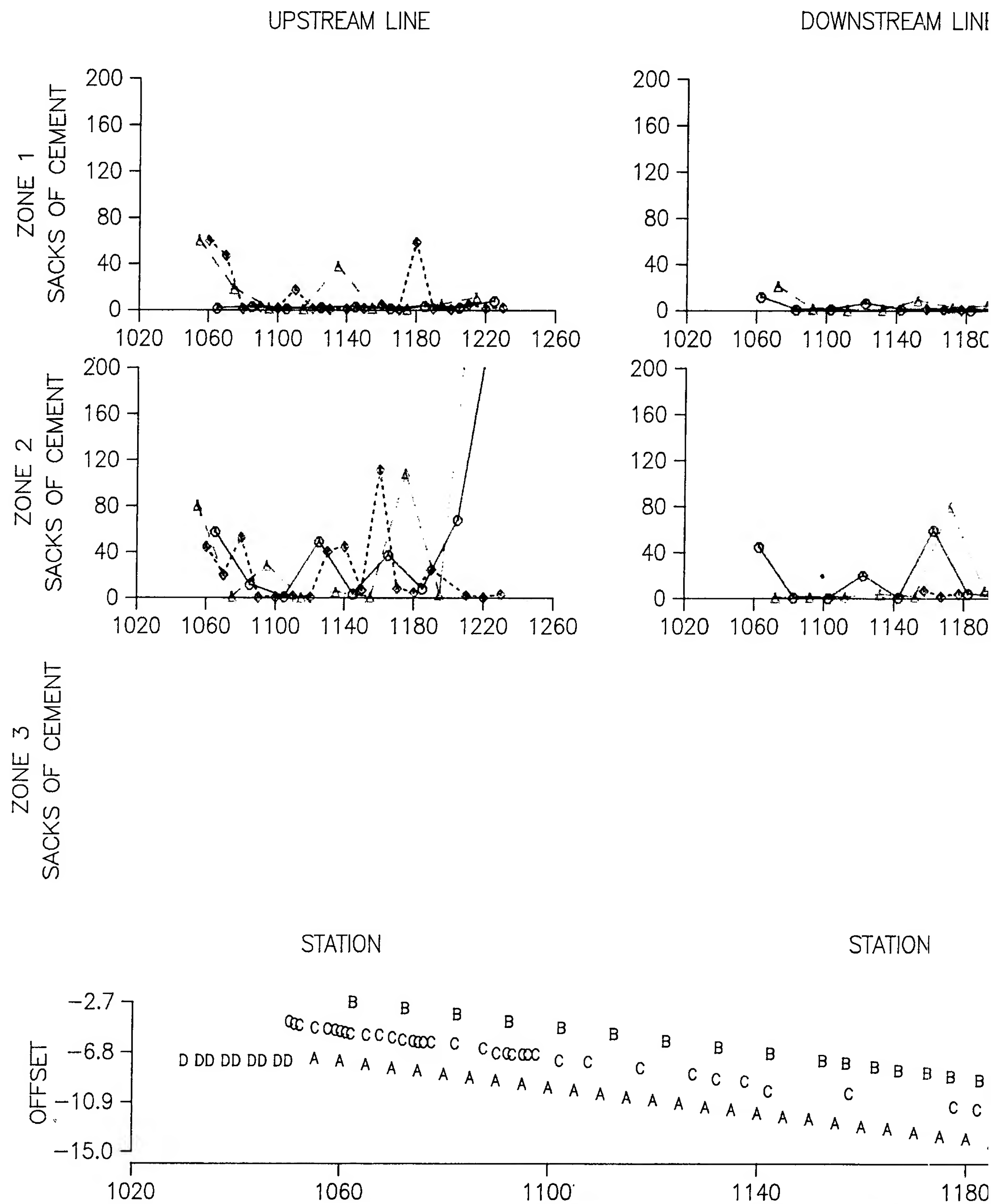
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

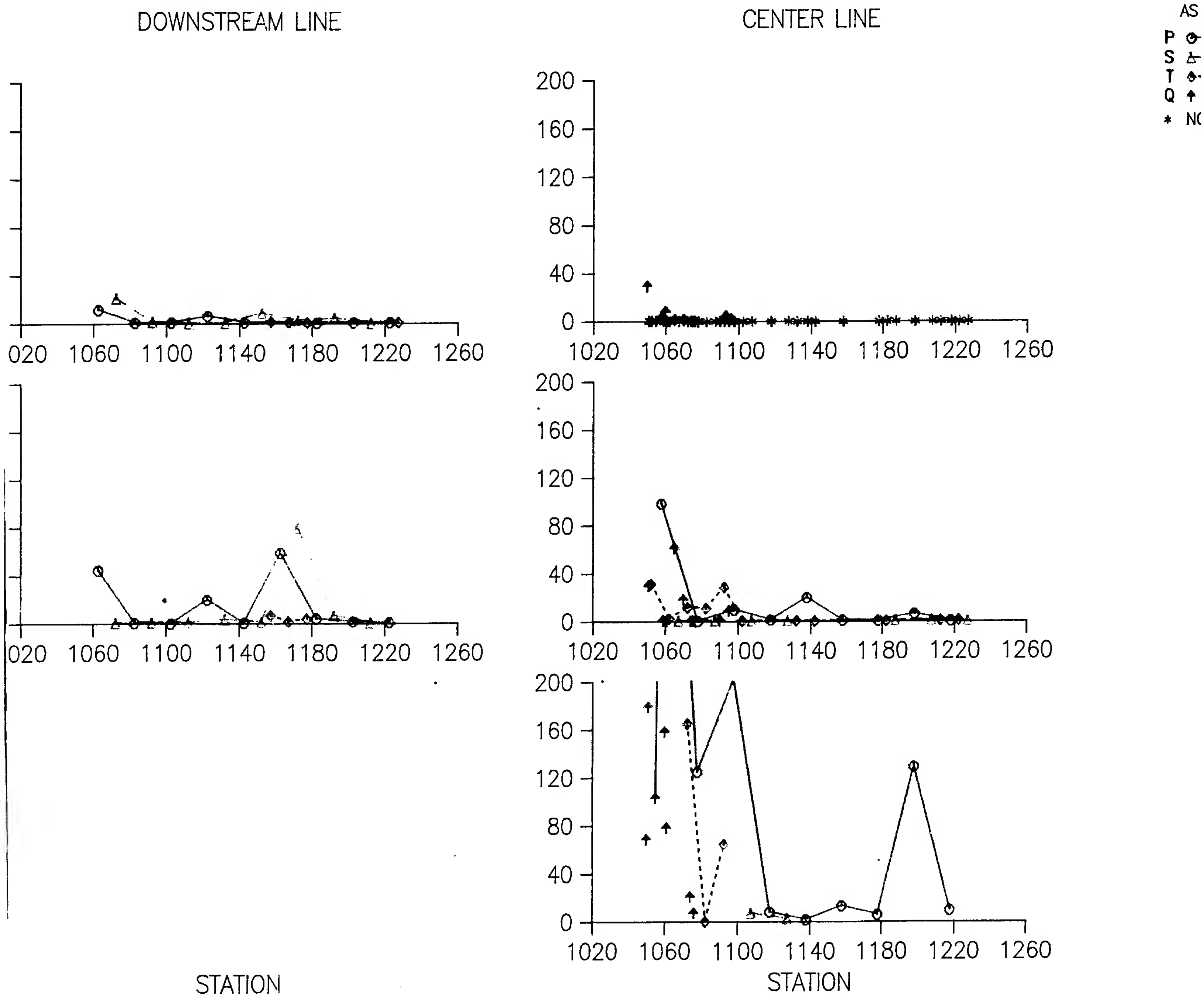
HOLES C2450–C2817

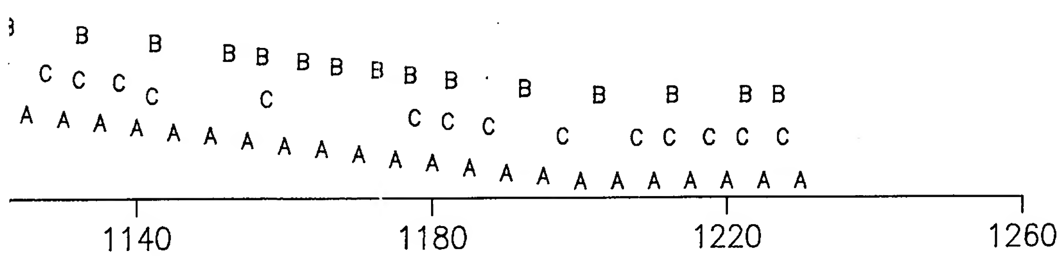
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Conege PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 69



Note: **Offsets shown are in feet, upstream from dam axis**
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address anomalous cond
extend the grout curtain at the upper l





C - **Center line of grout holes**

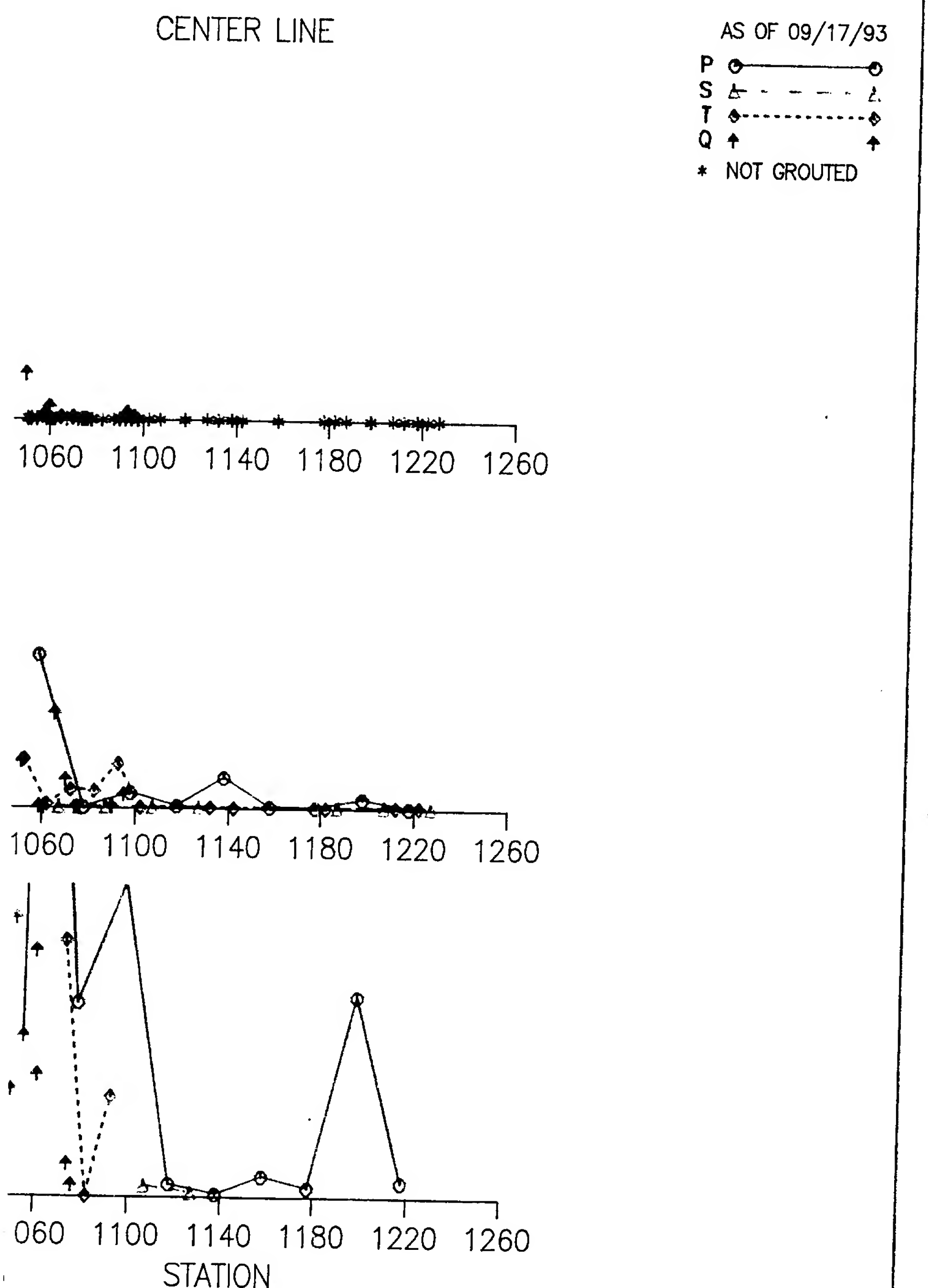
D - **Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment**

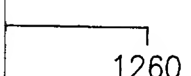
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTA
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STAT
STATION 10+30 TO 12+3

CORPS OF ENGINEERS, U.S. ARM
SACRAMENTO DISTRICT, SACRAMENTO, C

SUBMITTED: Robert L. [signature] for CARL E. COLE RES. GEOLOGIST			APPROVED: [signature] PAUL M. P RES. E
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PL





LITTLE DELL LAKE

SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

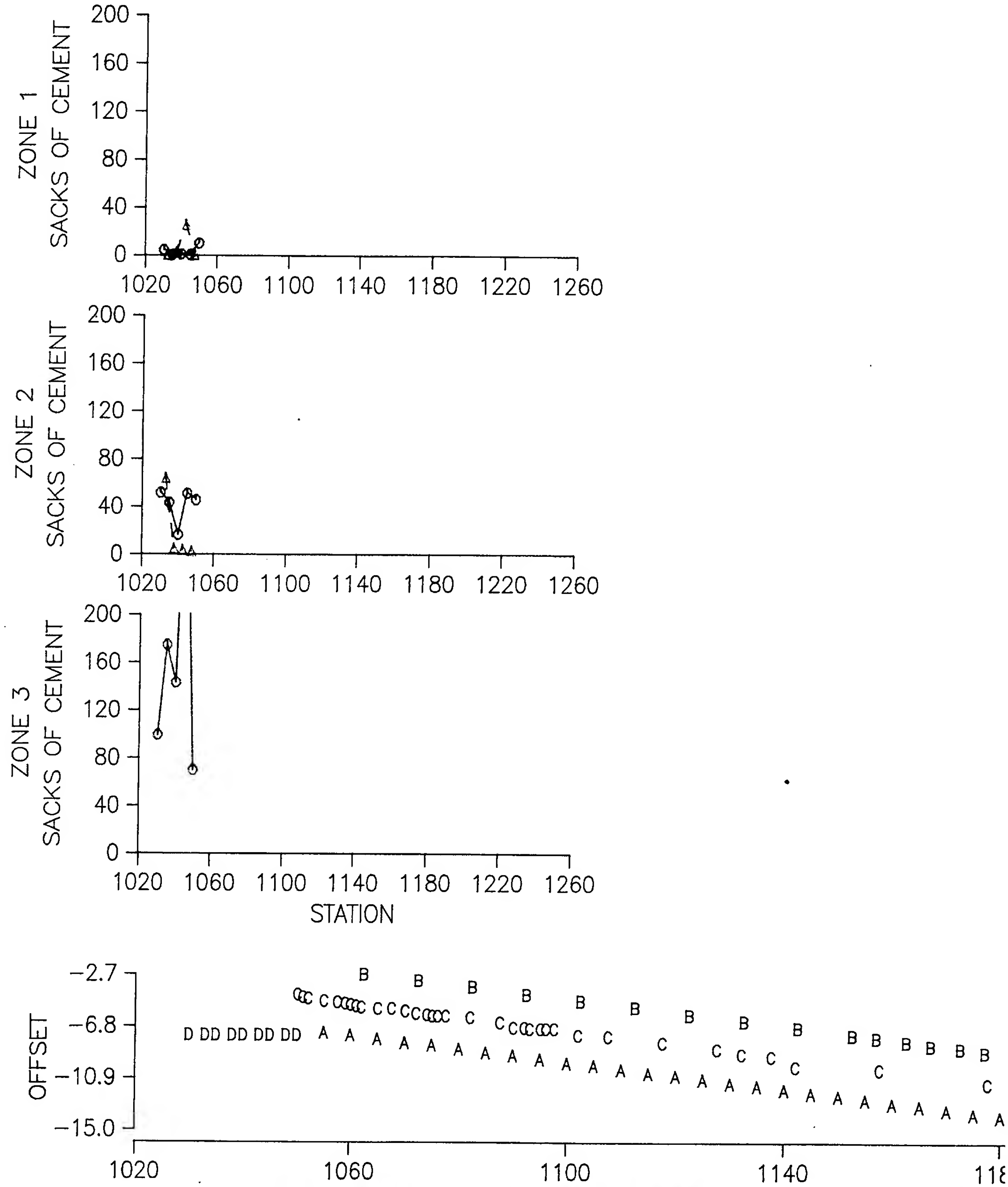
GROUT TAKE VERSUS STATION

STATION 10+30 TO 12+30

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [illegible] for CARL E. COLE RES. GEOLOGIST			APPROVED: [signature] PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. **PLATE 70**

ADDITIONAL LINE



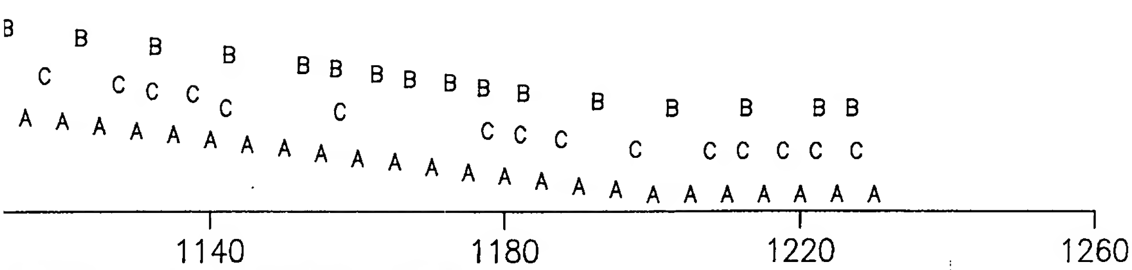
Note: **Offsets shown are in feet, upstream from dam axis**

A - **Upstream line of grout holes**

B - **Downstream line of grout holes**

C - **Center line of grout holes**

D - **Holes used to address anomalous extend the grout curtain at the u**



dam axis **C - Center line of grout holes**

D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

LITTLE DELL LA
SALT LAKE CITY STREA
FOUNDATION GROUT
GROUT TAKE VERSU
STATION 10+30 T
ADDITIONAL I

CORPS OF ENGINEERS,
SACRAMENTO DISTRICT, SACRAM

SUBMITTED: Robert L. Jusk for CARL E. COLE RES. GEOLOGIST			APP
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE

AS OF 09/17/93

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* NOT GROUTED

1260

LITTLE DELL LAKE

SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION

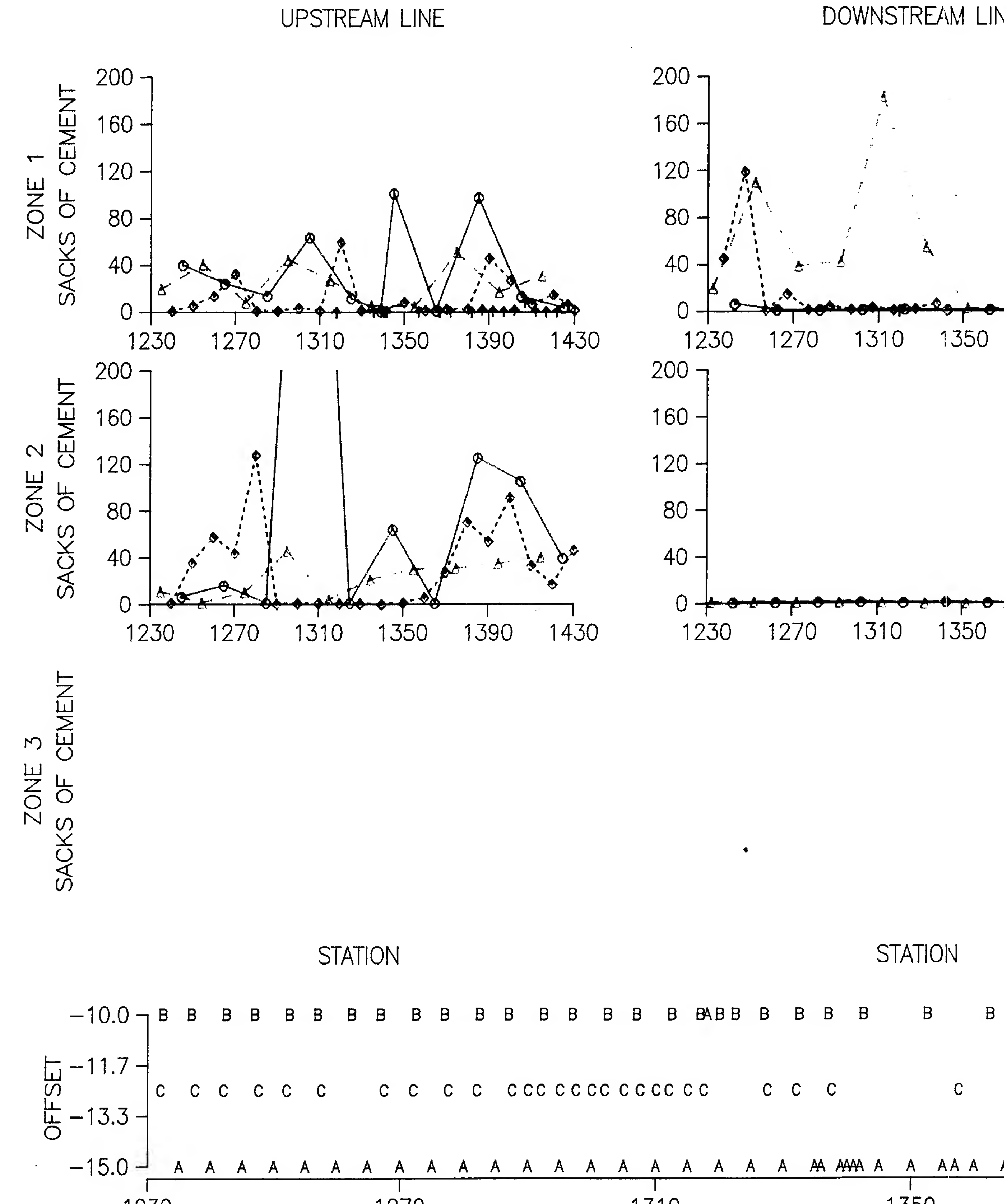
STATION 10+30 TO 10+50

ADDITIONAL LINE

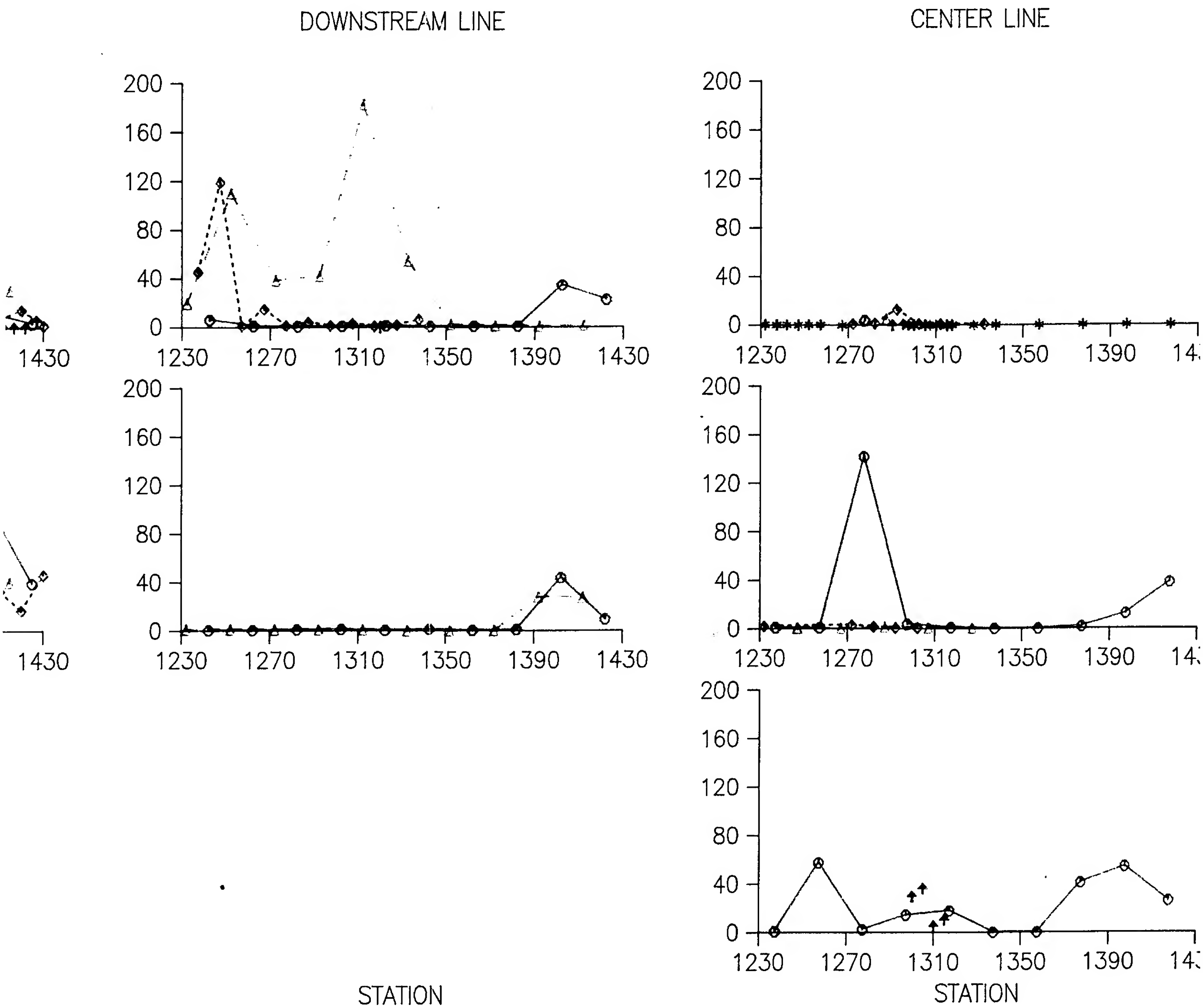
CORPS OF ENGINEERS, U.S. ARMY

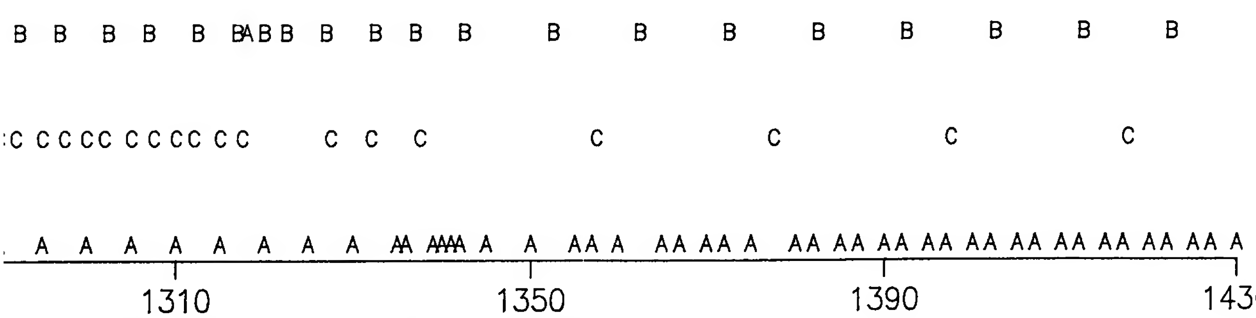
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [illegible] for CARL E. COLE RES. GEOLOGIST			APPROVED: PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 71



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address anomalous
extend the grout curtain at the up





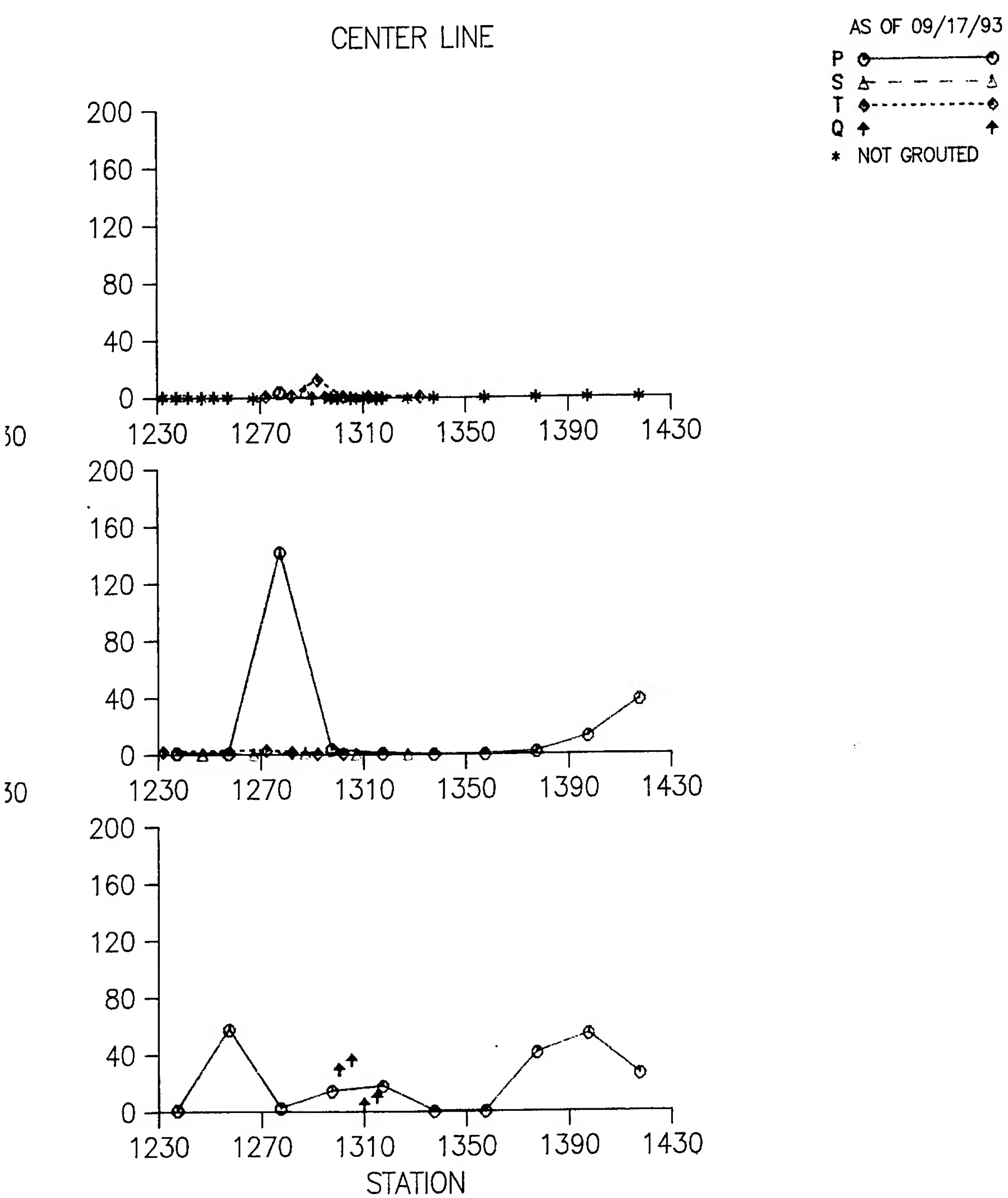
pstream from dam axis
t holes
out holes

C - Center line of grout holes

D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

SALT LA
FOUNI
GROUT TA
STATIO
CORPS O
SACRAMENTO DIS
SUBMITTED: Robert L.
for CARL E. COLE
RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:



B B B B

C C

AA AA AA AA AA AA AA AA AA A

1390 1430

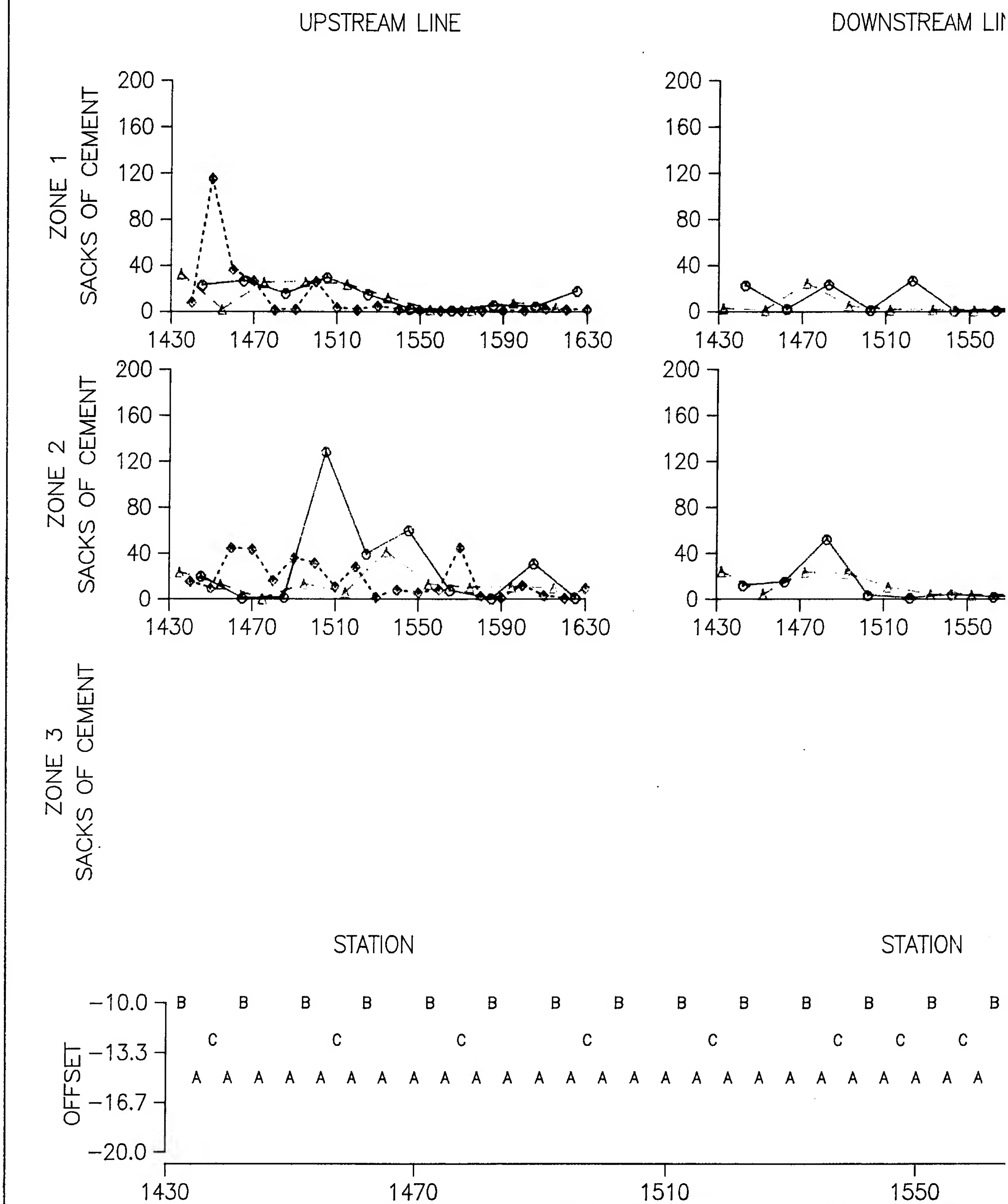
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION
STATION 12+31 TO 14+30

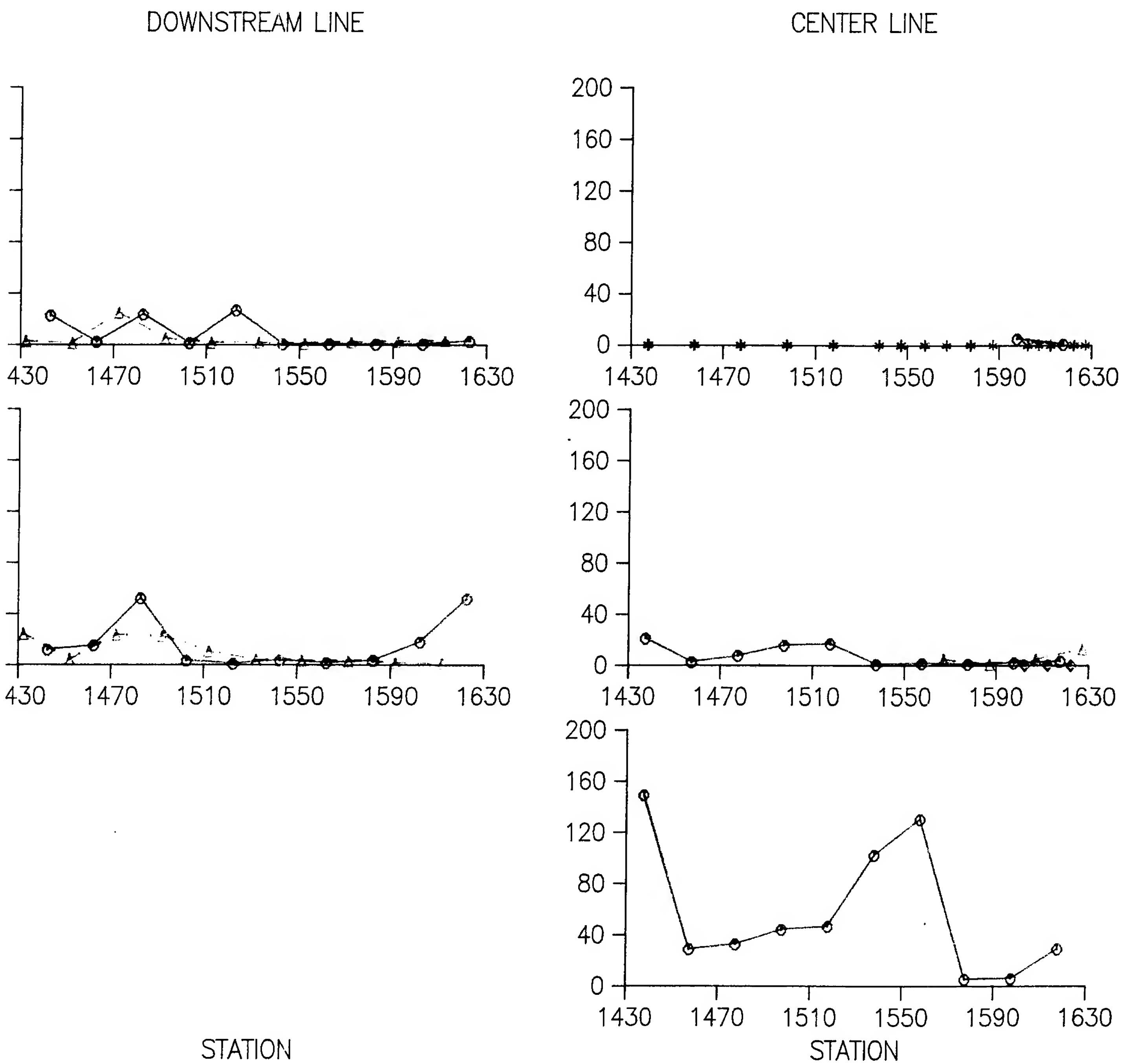
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

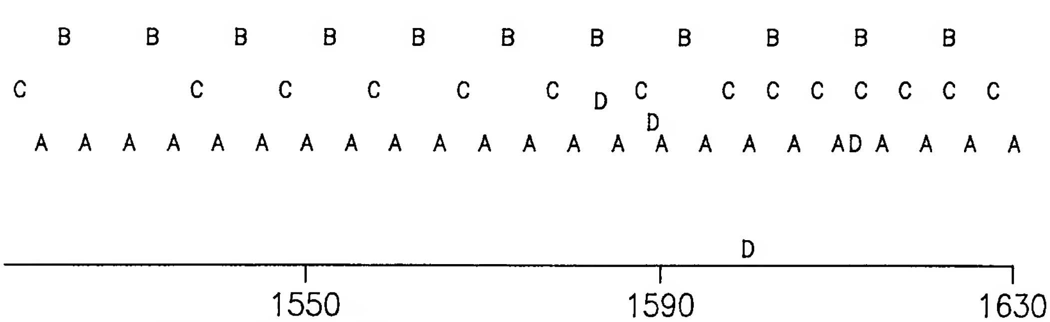
SUBMITTED: Robert L. Frost	APPROVED: for John Conroy
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 72



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address anomalou
extend the grout curtain at the





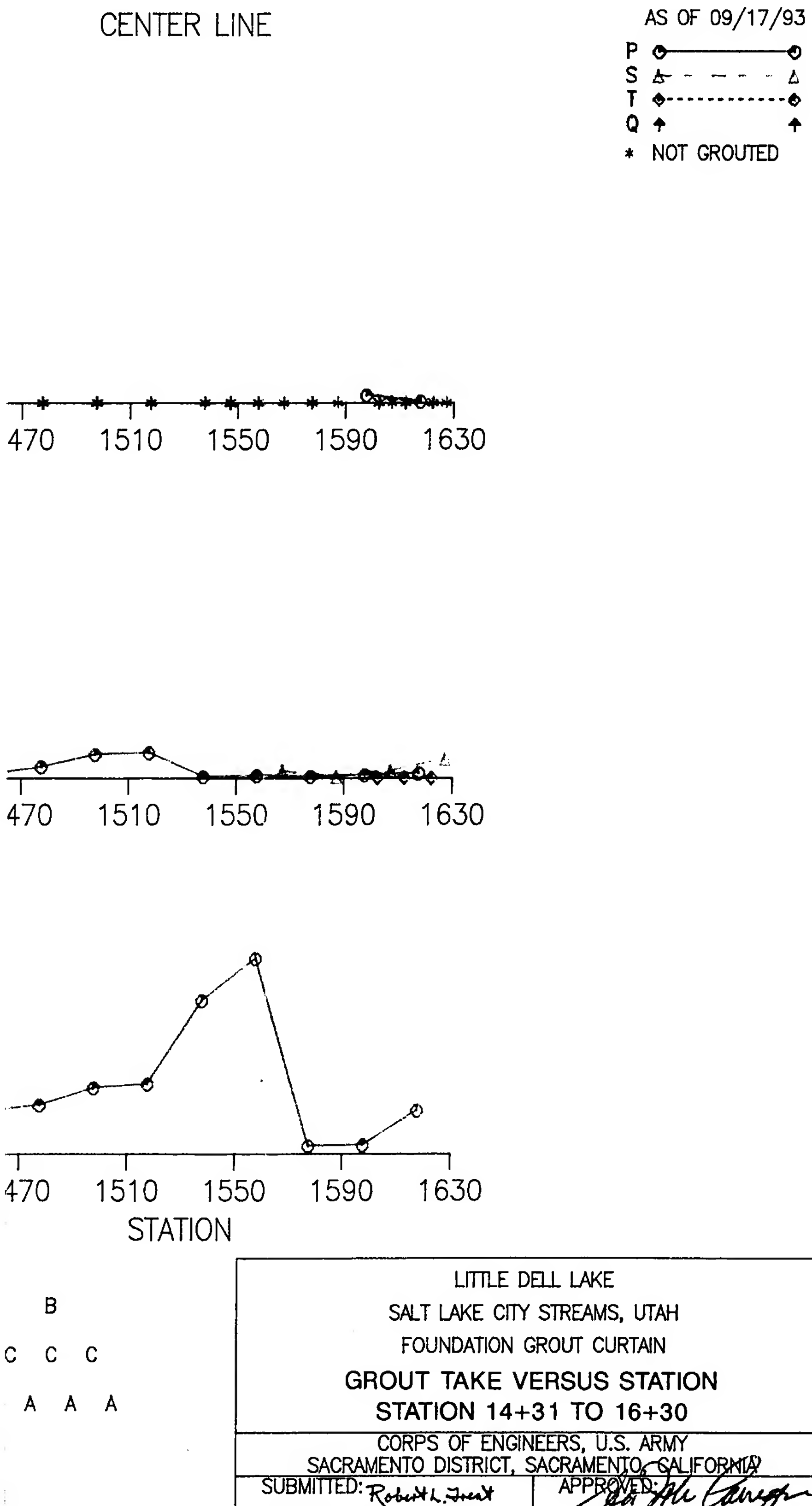
is

C - **Center line of grout holes**

D - **Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment**

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTA FOUNDATION GROUT CURTAIN GROUT TAKE VERSUS STA STATION 14+31 TO 16+3	
CORPS OF ENGINEERS, U.S. AR SACRAMENTO DISTRICT, SACRAMENTO,	
SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST	APPROVED: PAUL M. P RES. E
PLOTTED BY: | CHECKED BY: | GEOL. BY:	FILE NO. PLA

CENTER LINE



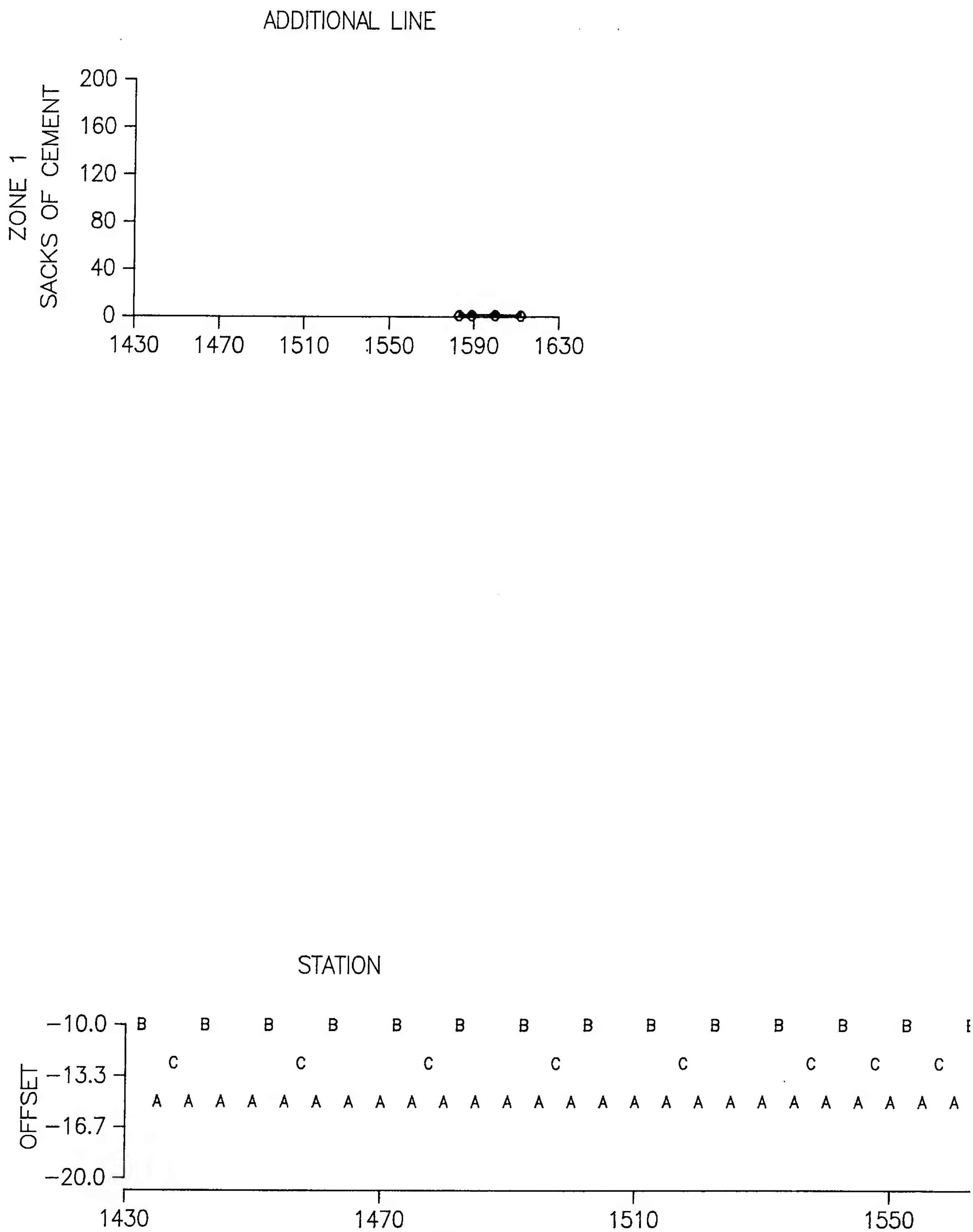
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION
STATION 14+31 TO 16+30

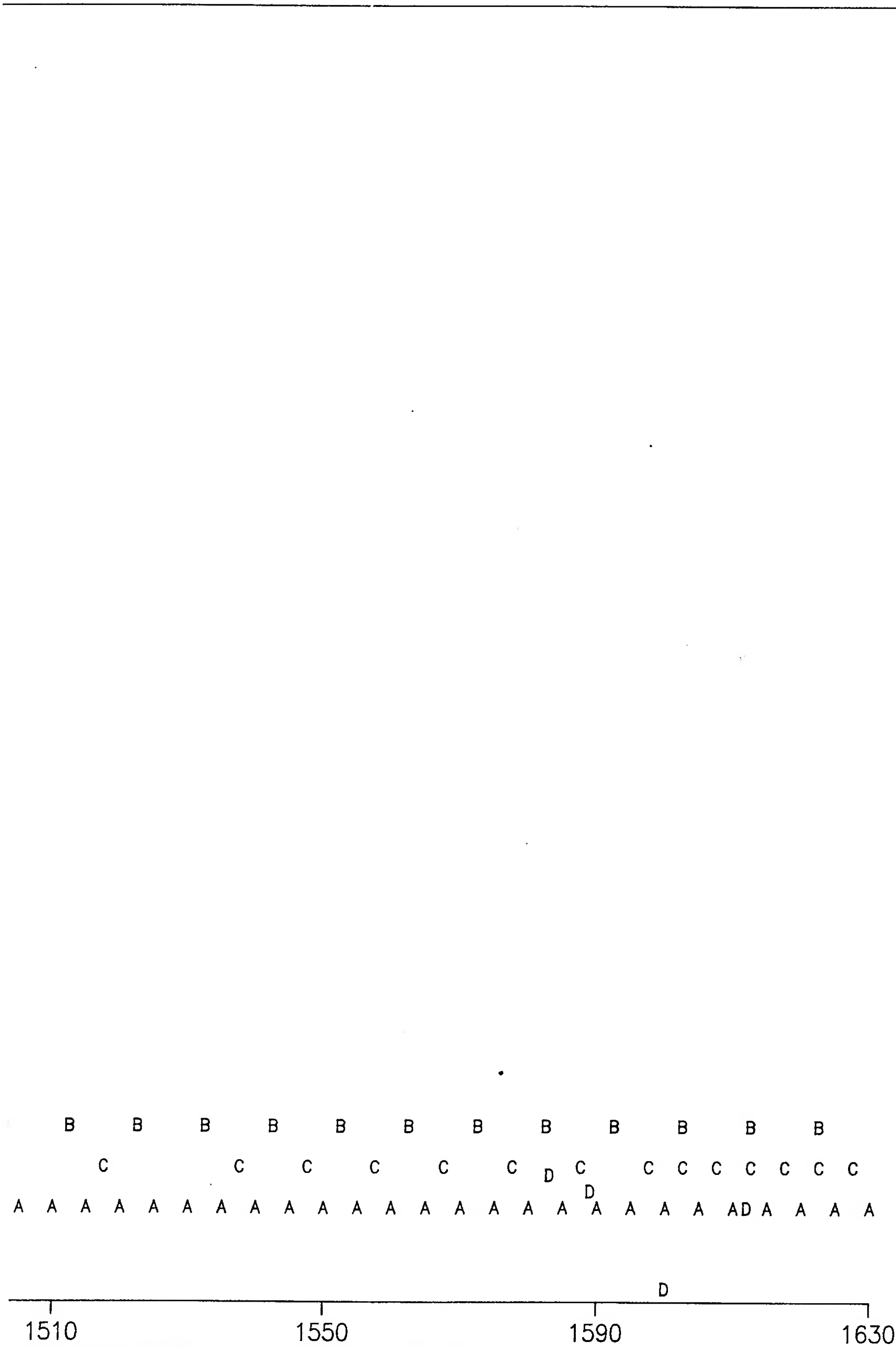
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frest	APPROVED:
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 73



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of g
D - Holes used to ad
extend the grout



ł, upstream from dam axis
ʼout holes
ʼ grout holes

C - Center line of grout holes
D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

LITTLE DELI
SALT LAKE CITY S
FOUNDATION GRO
GROUT TAKE VE
STATION 14+3
ADDITIONA
CORPS OF ENGINEE
SACRAMENTO DISTRICT, SAC
SUBMITTED: Robert L. [illegible]
for CARL E. COLE
RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:

AS OF 09/17/93

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* NOT GROUTED

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LITTLE DELL LAKE

SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

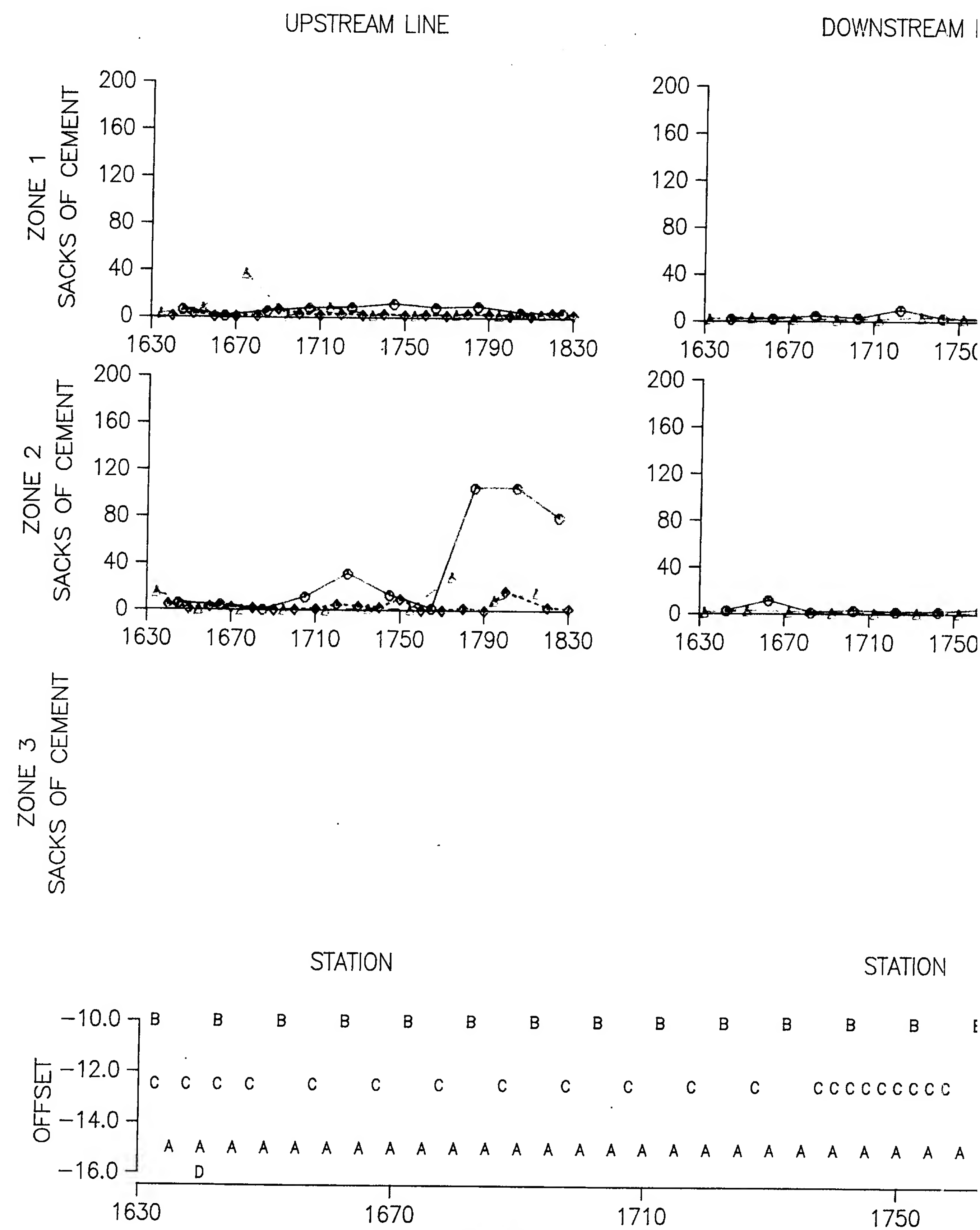
GROUT TAKE VERSUS STATION

STATION 14+31 TO 16+30

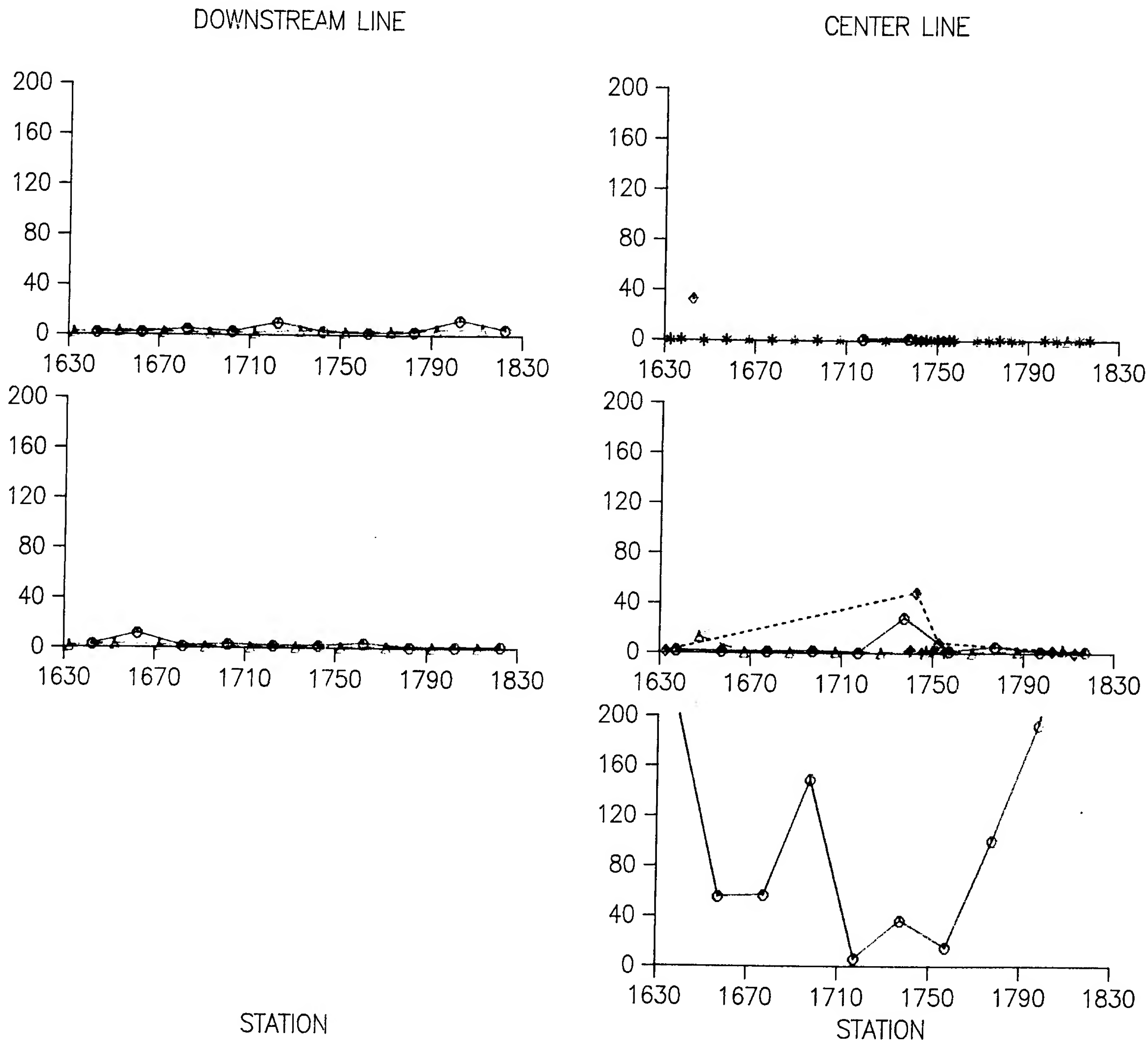
ADDITIONAL LINE

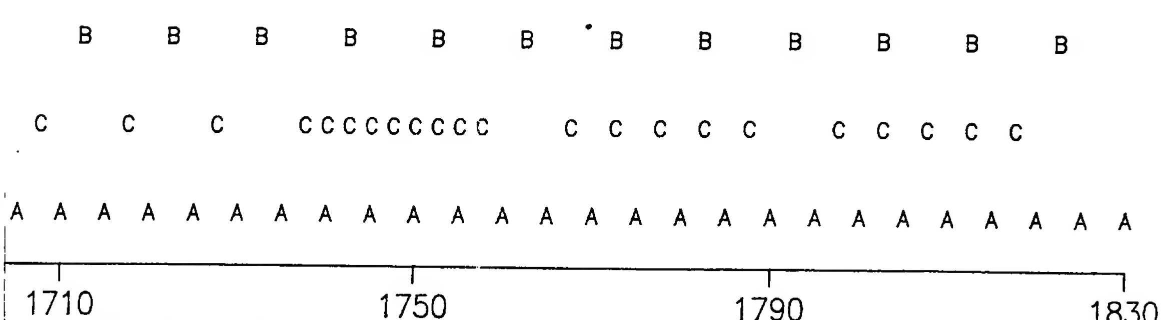
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Smit for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Canegi PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 74



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of
D - Holes used to
extend the grou





...et, upstream from dam axis
...grout holes
...of grout holes

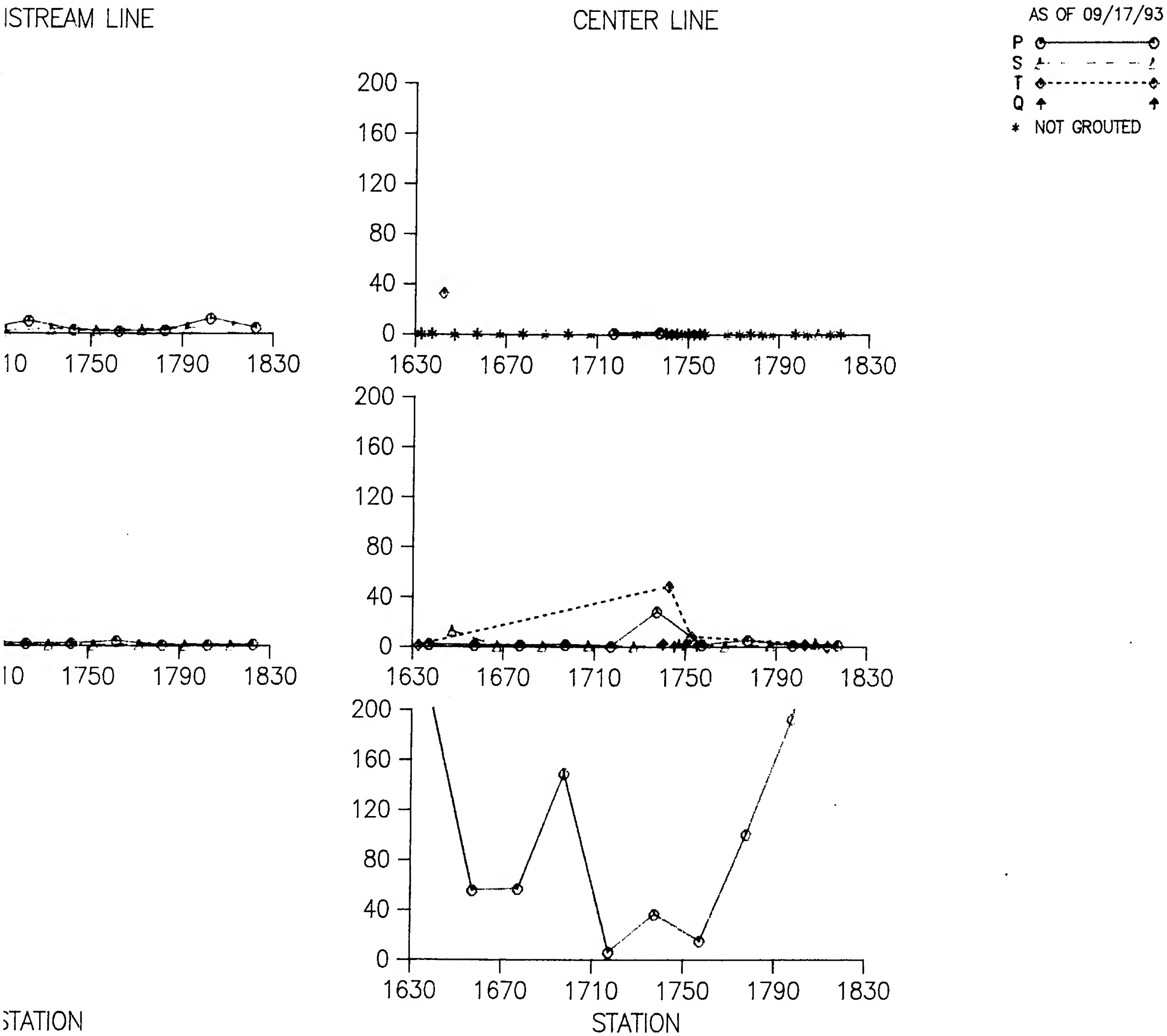
C - **Center line of grout holes**
D - **Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment**

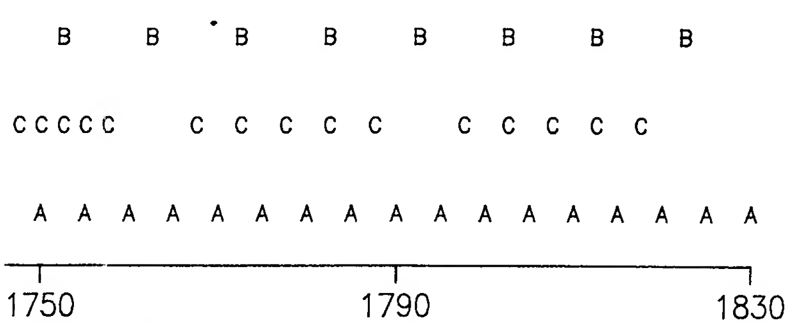
LITTLE DELL
SALT LAKE CITY STR...
FOUNDATION GROU...
GROUT TAKE VERS...
STATION 16+31

CORPS OF ENGINEERS
SACRAMENTO DISTRICT, SACR...

SUBMITTED: Robert L. Frost
for CARL E. COLE
RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FI...





Center line of grout holes
Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

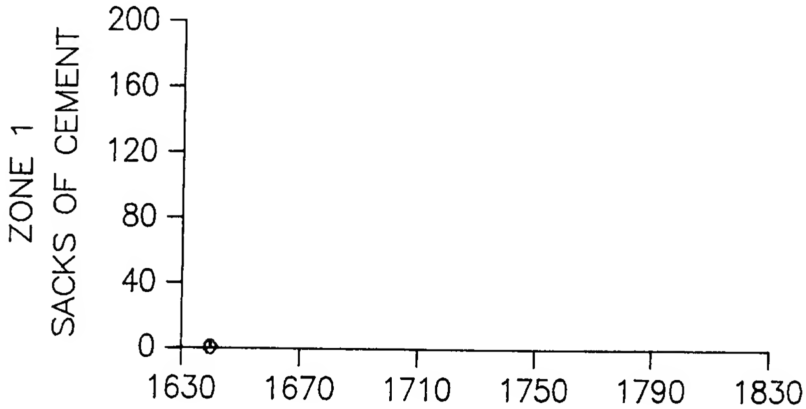
GROUT TAKE VERSUS STATION
STATION 16+31 TO 18+30

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

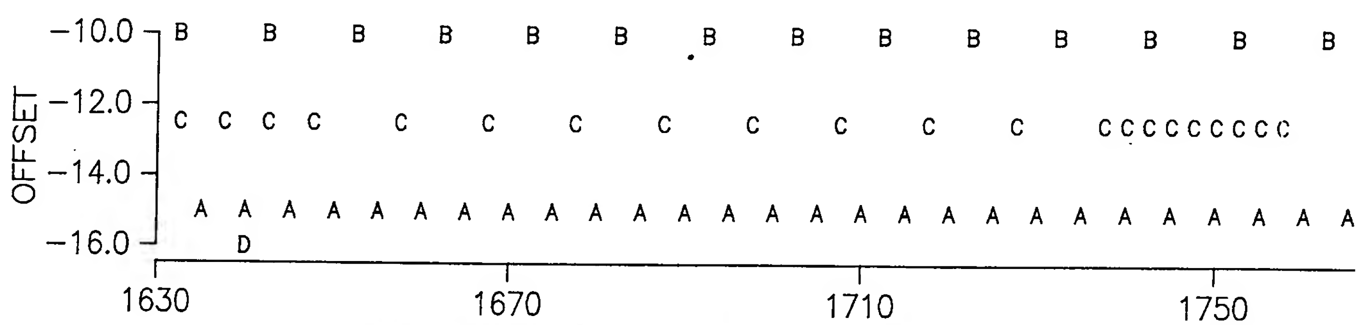
SUBMITTED: Robert L. [illegible]	APPROVED: [illegible]
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 75

ADDITIONAL LINE



STATION



Note: **Offsets shown are in feet, upstream from dam axis**

A - Upstream line of grout holes

B - Downstream line of grout holes

C - Center line of grout holes

D - Holes used to address anomalous

extend the grout curtain at the u

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dam axis

C - Center line of grout holes

D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

LITTLE DELL LAKE

SALT LAKE CITY STREAMS

FOUNDATION GROUT CU

GROUT TAKE VERSUS

STATION 16+31 TO

ADDITIONAL LI

CORPS OF ENGINEERS, U.

SACRAMENTO DISTRICT, SACRAME

SUBMITTED: Robert L. Frost			APPR
for CARL E. COLE			PAUL
RES. GEOLOGIST			
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE N

AS OF 09/17/93

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* NOT GROUTED

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C C

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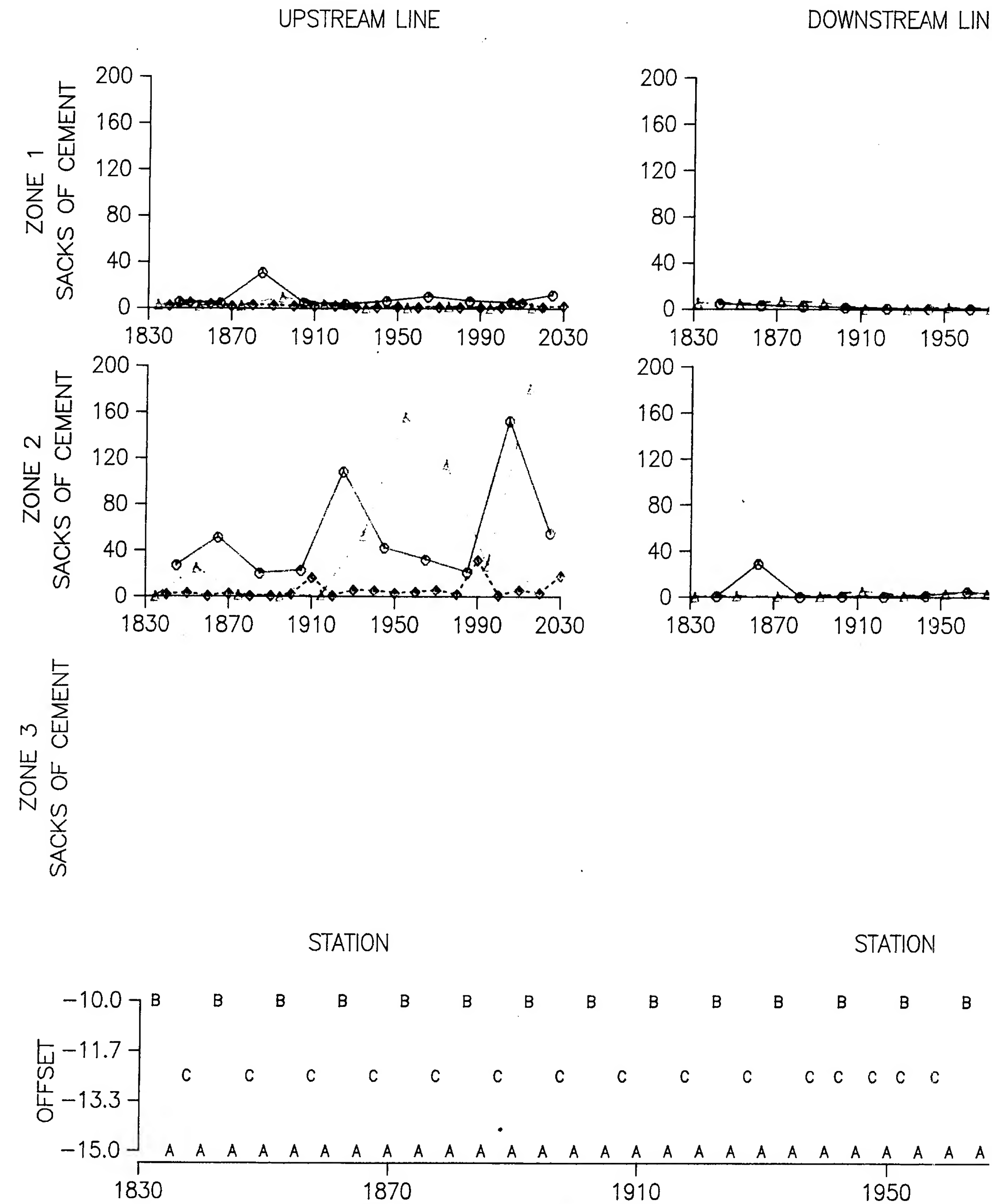
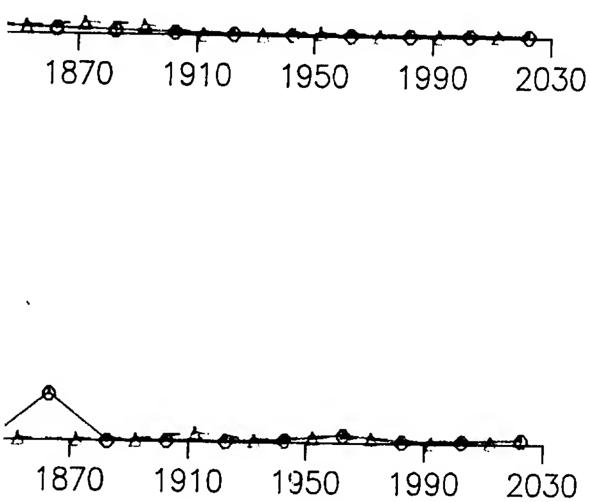
LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH FOUNDATION GROUT CURTAIN GROUT TAKE VERSUS STATION STATION 16+31 TO 18+30 ADDITIONAL LINE			
CORPS OF ENGINEERS, U.S. ARMY SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA			
SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 76



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address anomalous
extend the grout curtain at the u

DOWNSTREAM LINE



STATION

CENTER LINE

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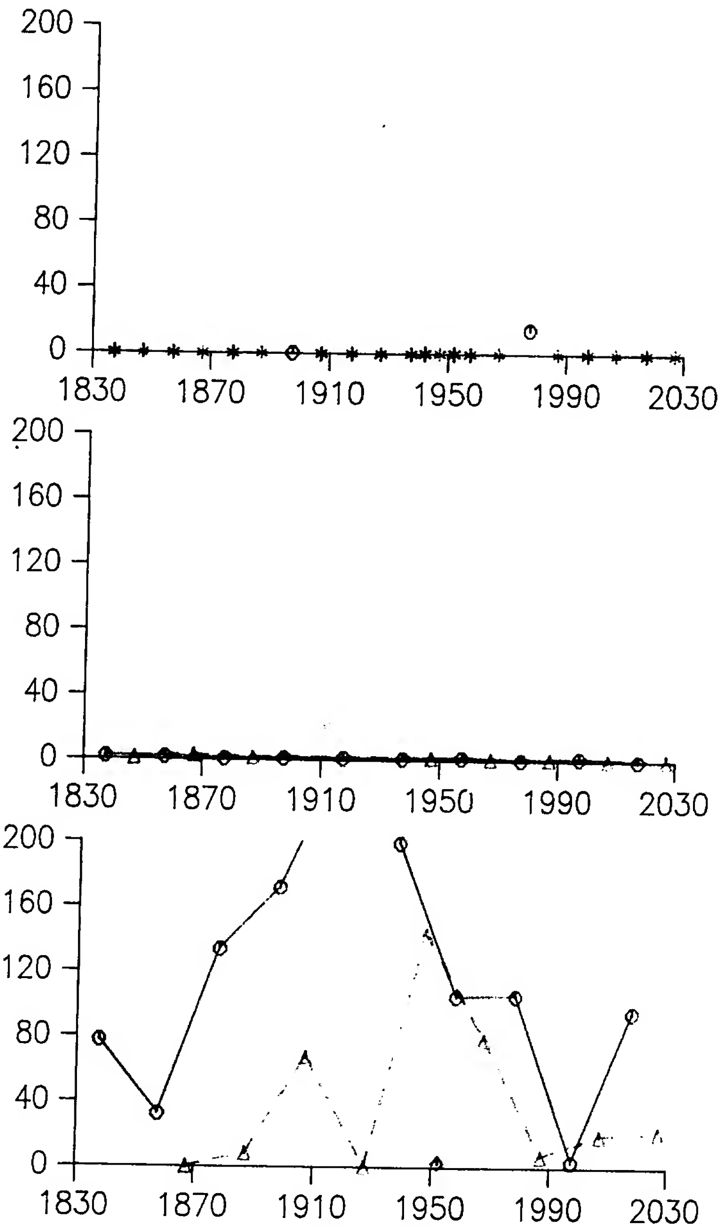
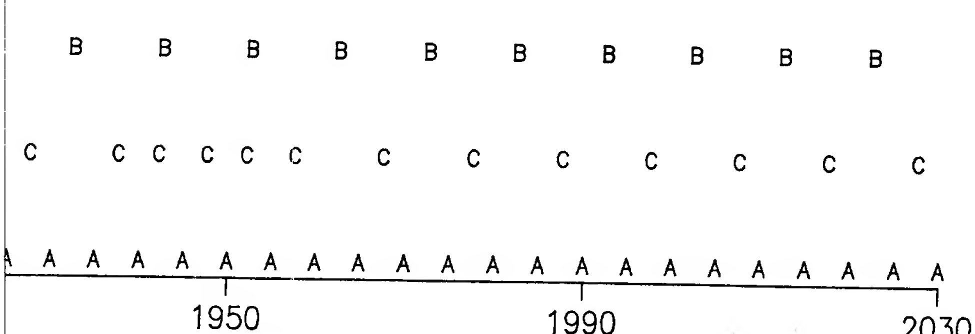


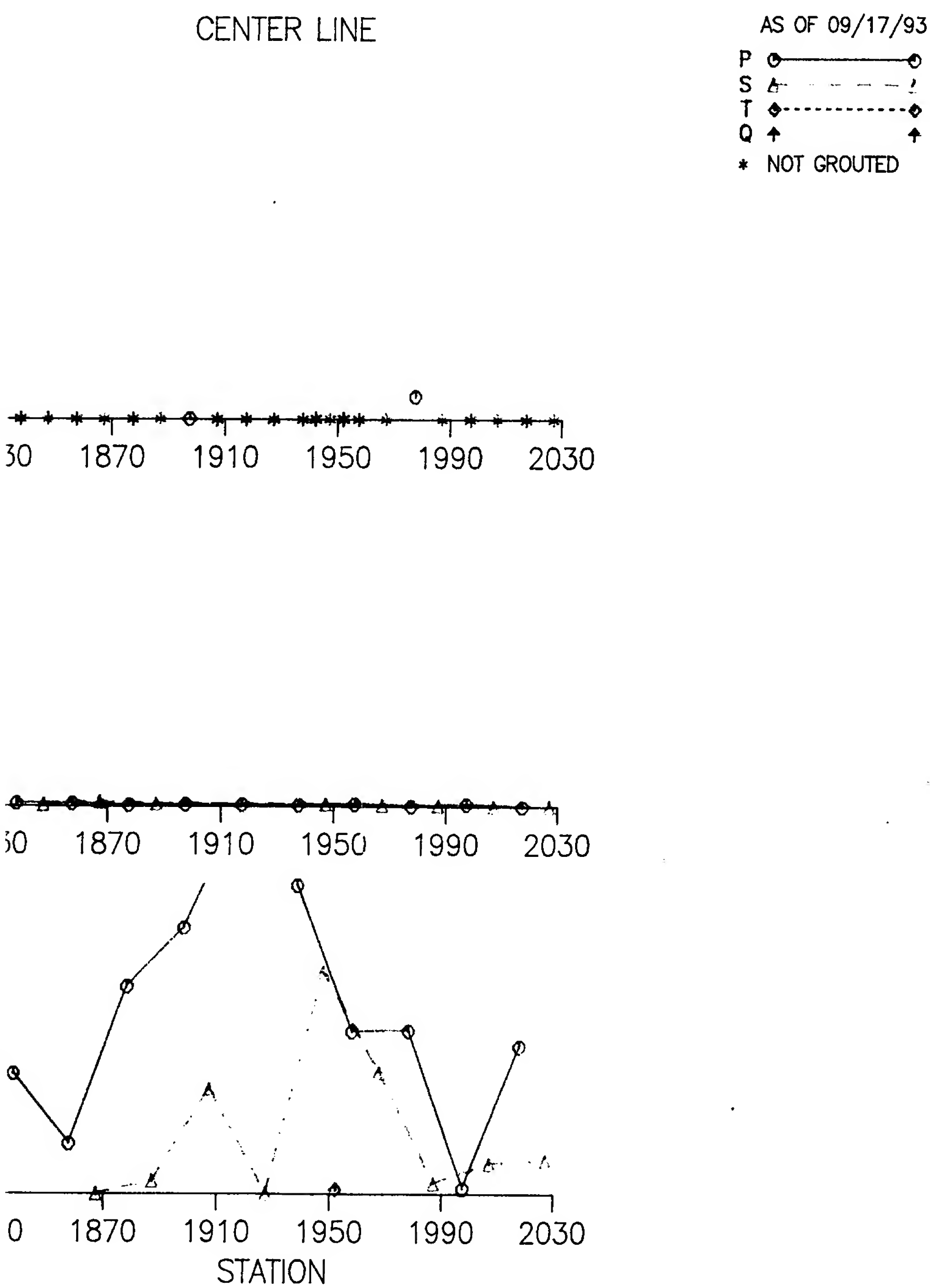
STATION

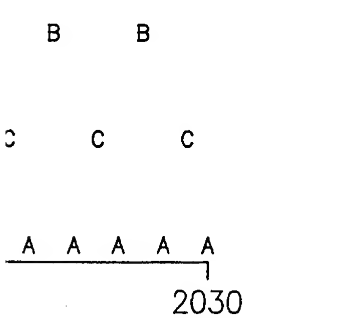


C - Center line of grout holes

D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH FOUNDATION GROUT CURTAIN **GROUT TAKE VERSUS STATION STATION 18+31 TO 20+30**			
CORPS OF ENGINEERS, U.S. ARMY SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNI			
SUBMITTED: Robert L. Trust for CARL E. COLE RES. GEOLOGIST			APPROVED: PAUL M. PARSONEAU RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 77





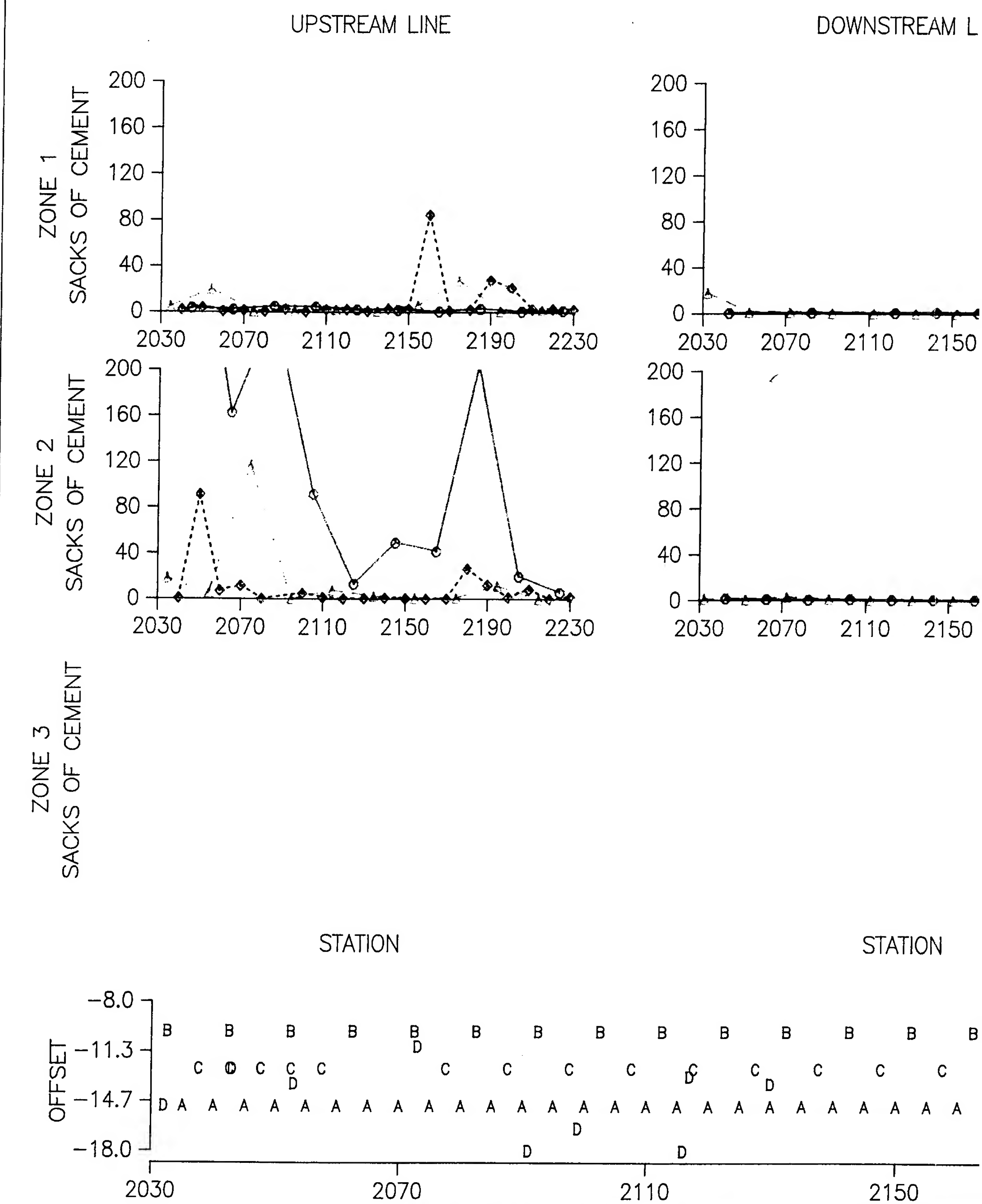
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION
STATION 18+31 TO 20+30

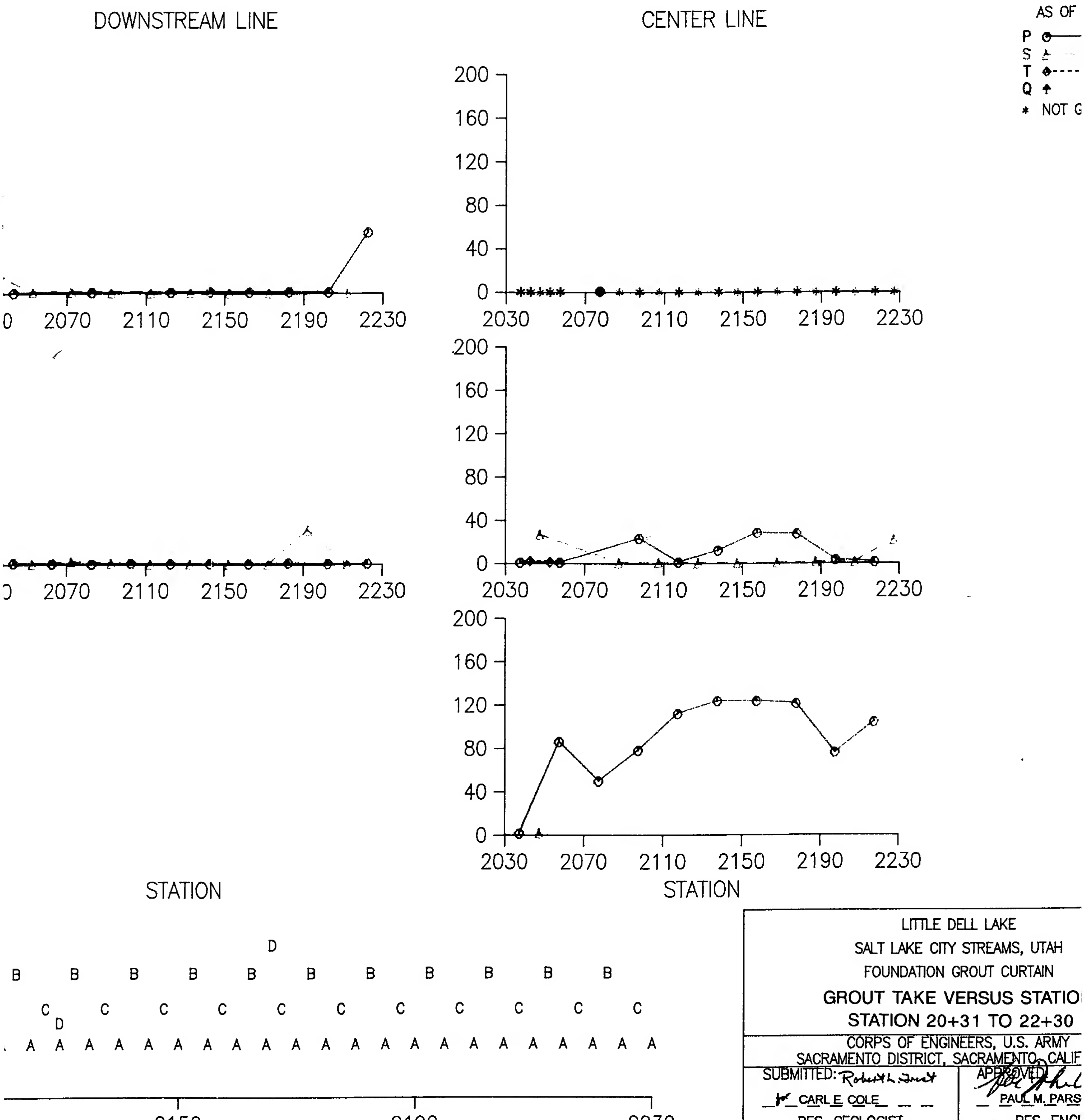
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost	APPROVED: for John Carrigan
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO.
			PLATE 77



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address and
extend the grout curtain

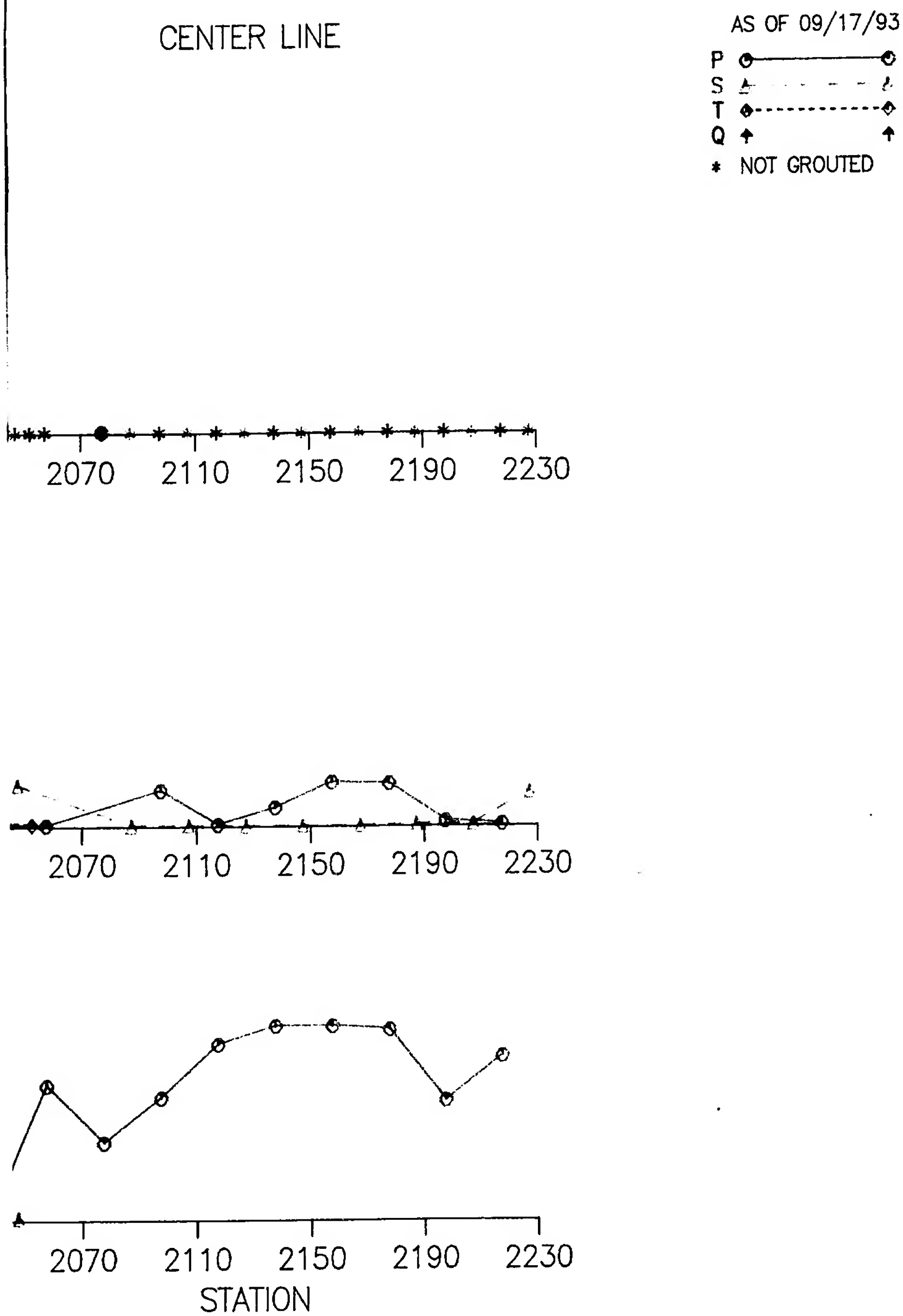


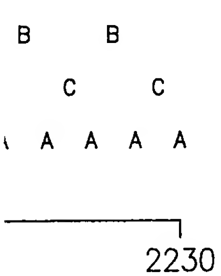
cis

C - **Center line of grout holes**

D - **Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment**

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH FOUNDATION GROUT CURTAIN **GROUT TAKE VERSUS STATIO** **STATION 20+31 TO 22+30**			
CORPS OF ENGINEERS, U.S. ARMY SACRAMENTO DISTRICT, SACRAMENTO, CALIF			
SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: PAUL M. PARS RES. ENGI
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE





LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

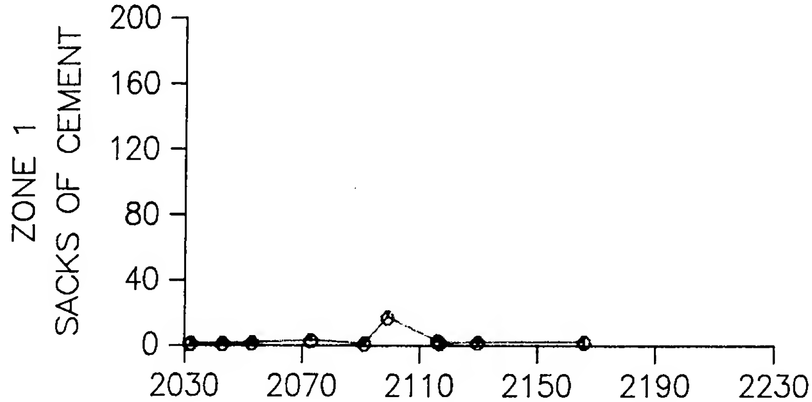
GROUT TAKE VERSUS STATION
STATION 20+31 TO 22+30

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

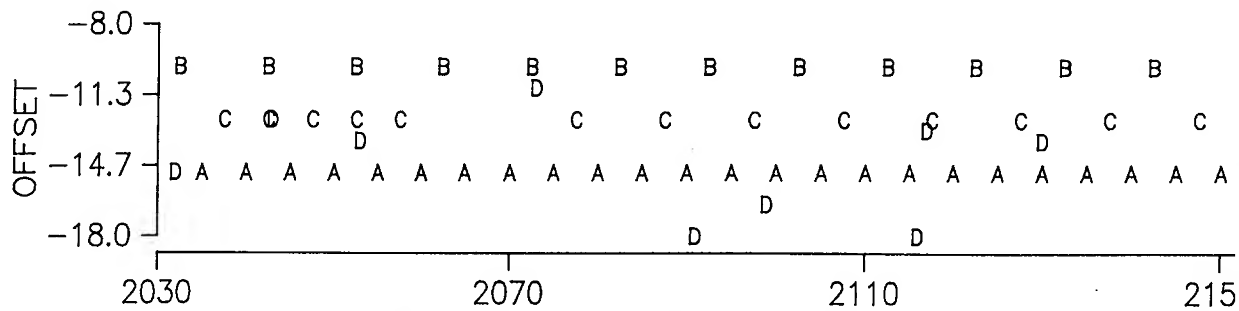
SUBMITTED: Robert L. Trust for CARL E. COLE RES. GEOLOGIST	APPROVED: for John Carrigan PAUL M. PARSONEAULT RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 78

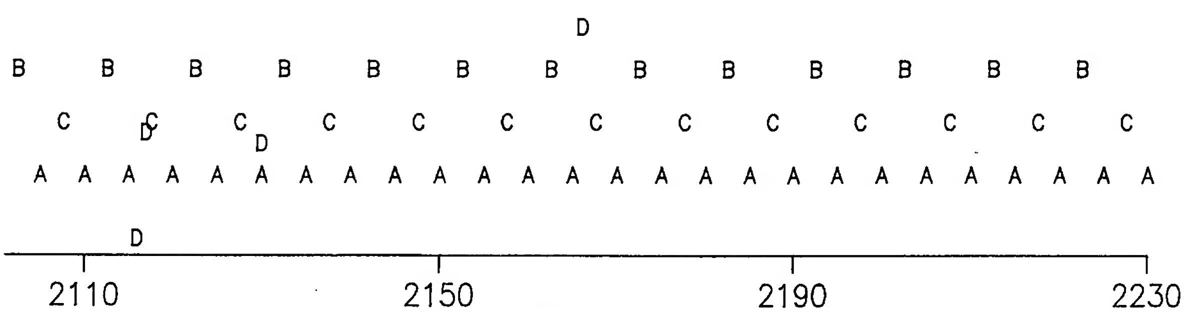
ADDITIONAL LINE



STATION



Note: **Offsets shown are in feet, upstream from dam axis**
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of g
D - Holes used to a
extend the grou



ream from dam axis
les
holes

C - Center line of grout holes
D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

LITTLE DE
SALT LAKE CITY
FOUNDATION G
GROUT TAKE VE
STATION 20+3
ADDITIO

CORPS OF ENGINE
SACRAMENTO DISTRICT, S

SUBMITTED: Robert L. Frost
for CARL E. COLE
RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:

AS OF 09/17/93

P
S
T
Q
* NOT GROUTED

B B B

C C C C

A A A A A A A A

2230

LITTLE DELL LAKE

SALT LAKE CITY STREAMS, UTAH

FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION

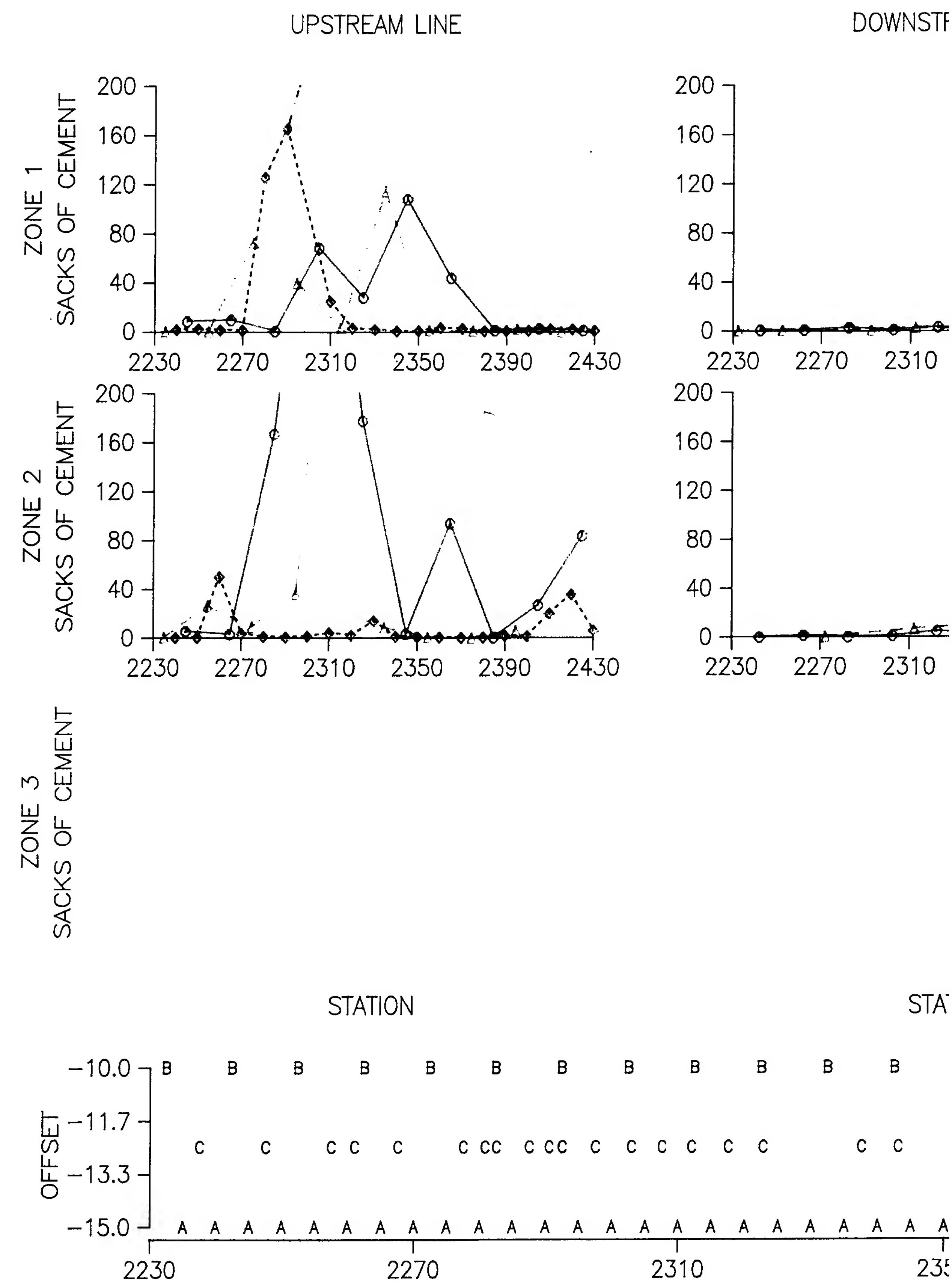
STATION 20+31 TO 22+30

ADDITIONAL LINE

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [illegible]	APPROVED: for John Camp[illegible]
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

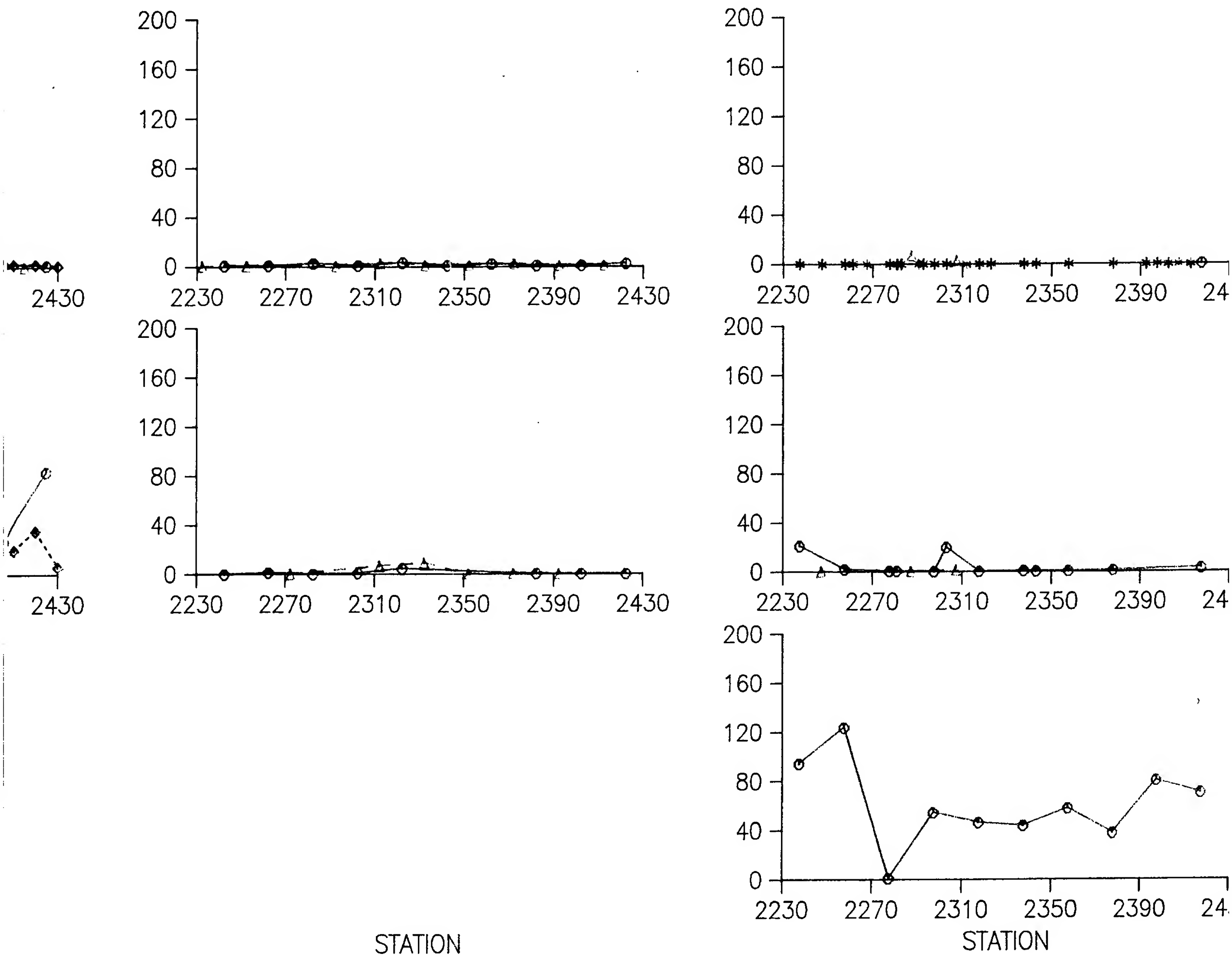
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO
			PLATE 79

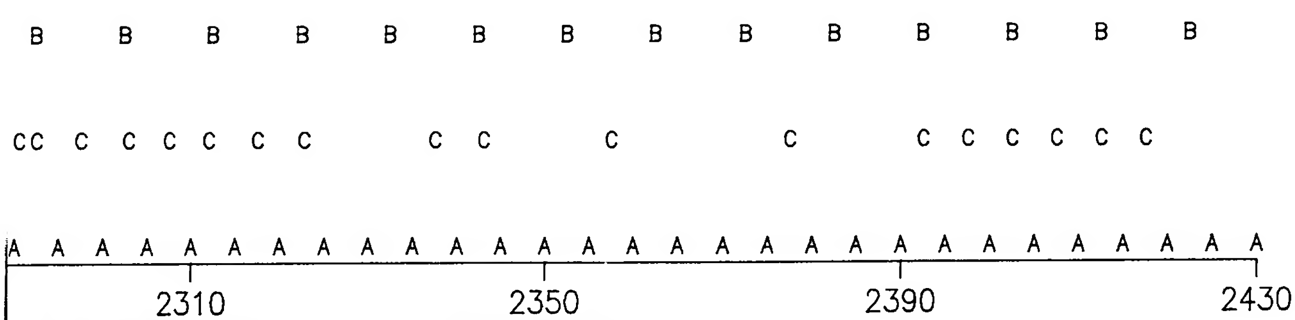


Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grou
D - Holes used to addr
extend the grout cu

DOWNSTREAM LINE

CENTER LINE





, upstream from dam axis
out holes
grout holes

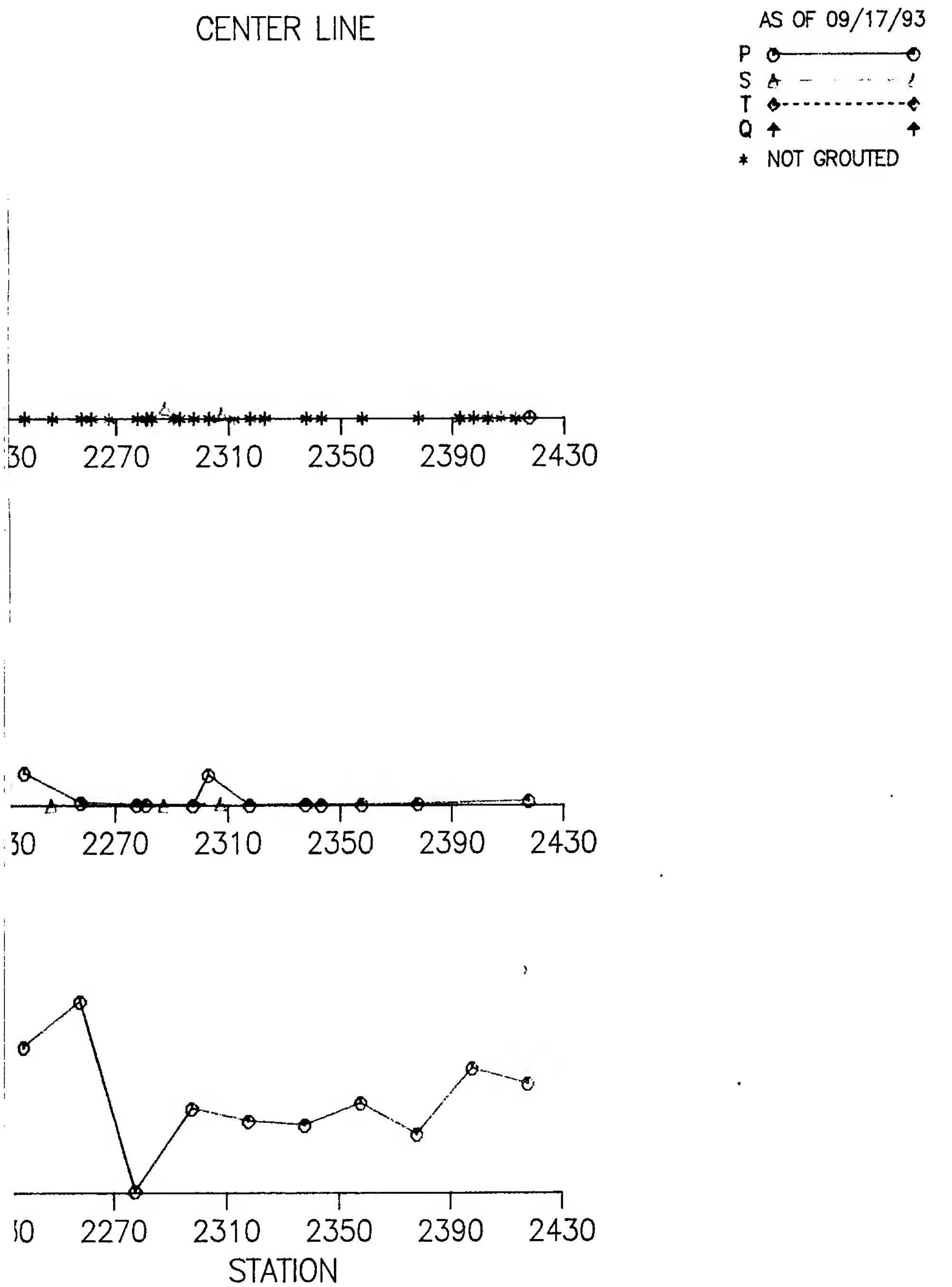
C - Center line of grout holes
D - Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment

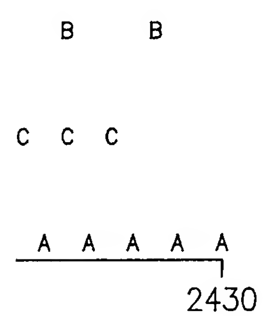
SALT L
FOUN
GROUT T
STATIO

CORPS
SACRAMENTO DI

SUBMITTED: Robert L.
for CARL E. COLE
RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:



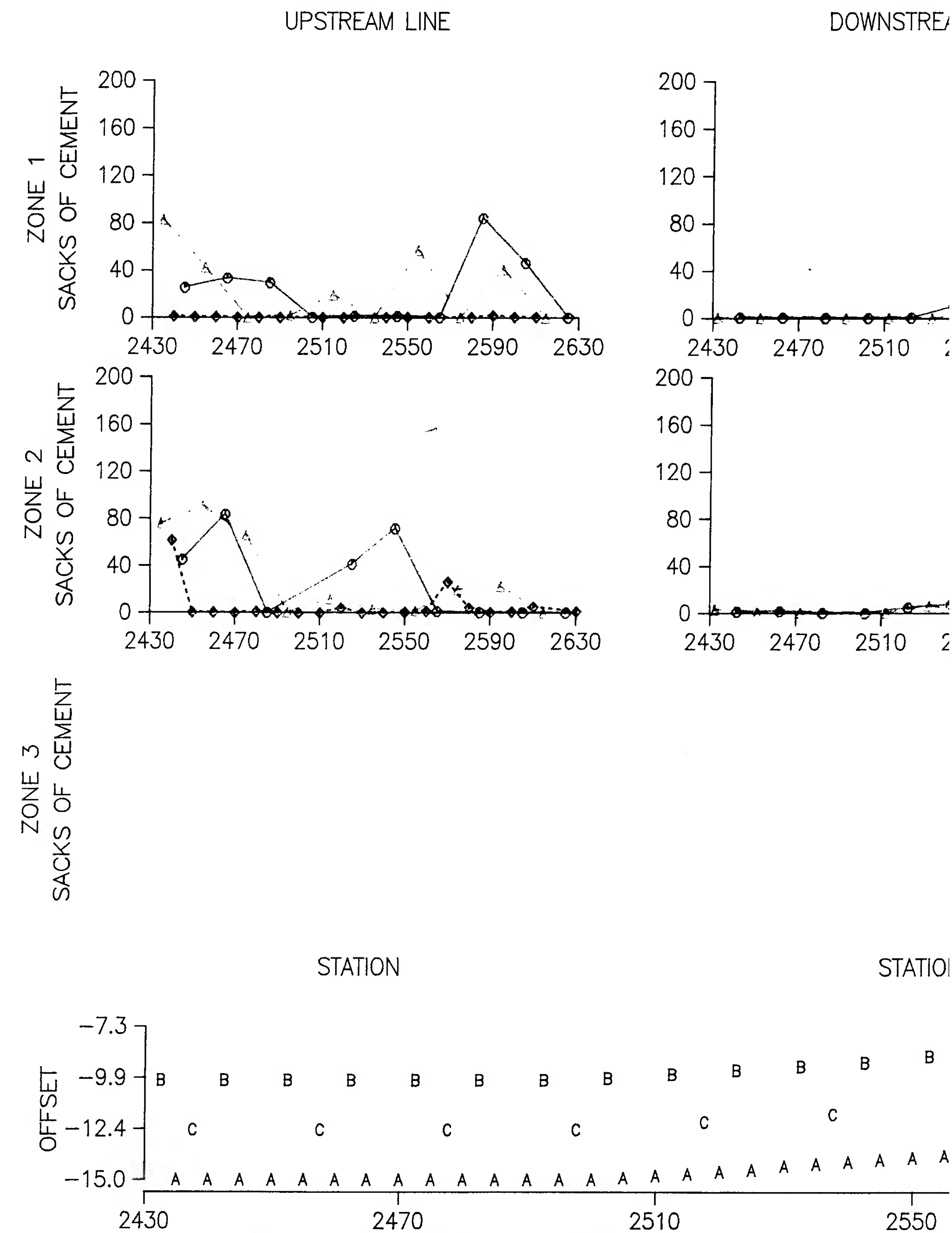


LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION
STATION 22+31 TO 24+30

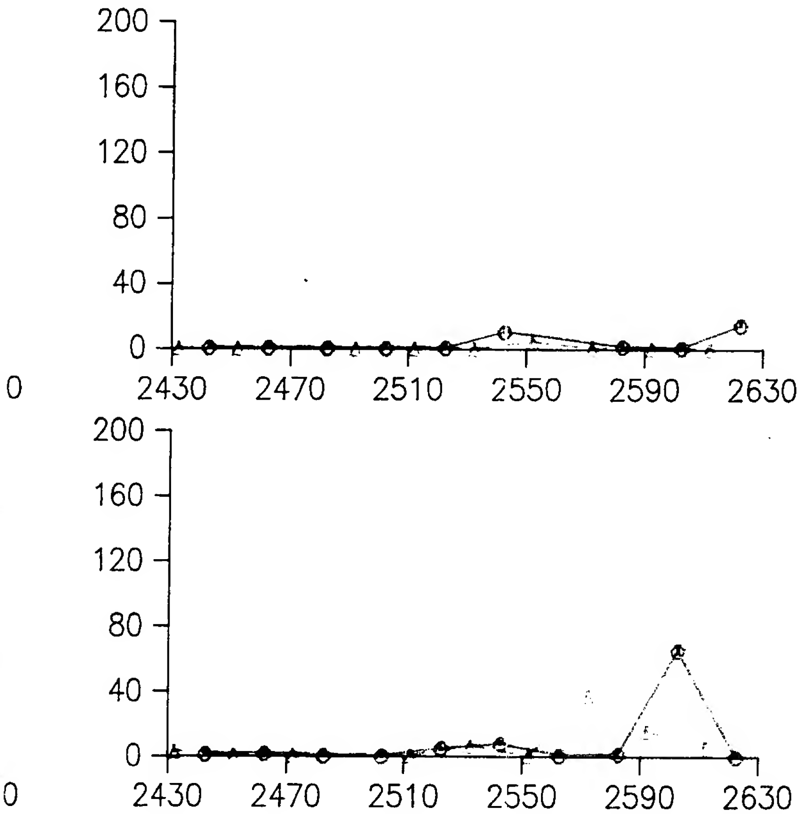
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Trust for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Carney PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. **PLATE 80**



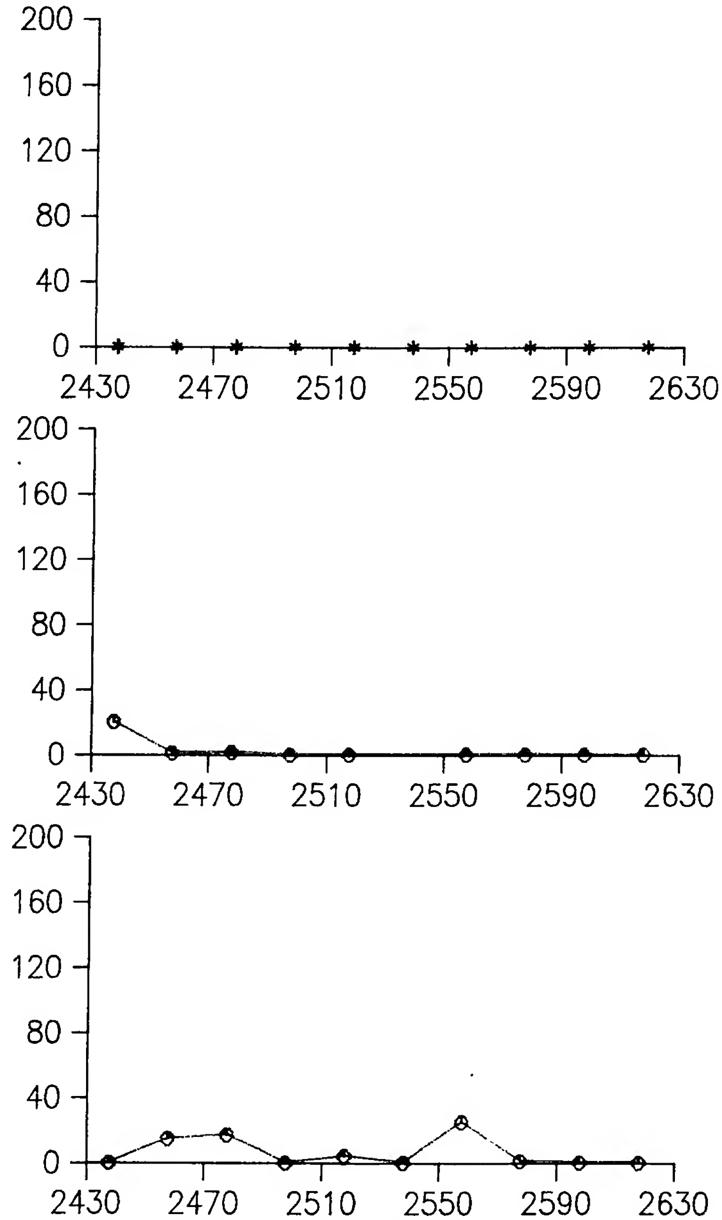
Note: **Offsets shown are in feet, upstream from dam axis**
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address anomalo
extend the grout curtain at the

DOWNSTREAM LINE

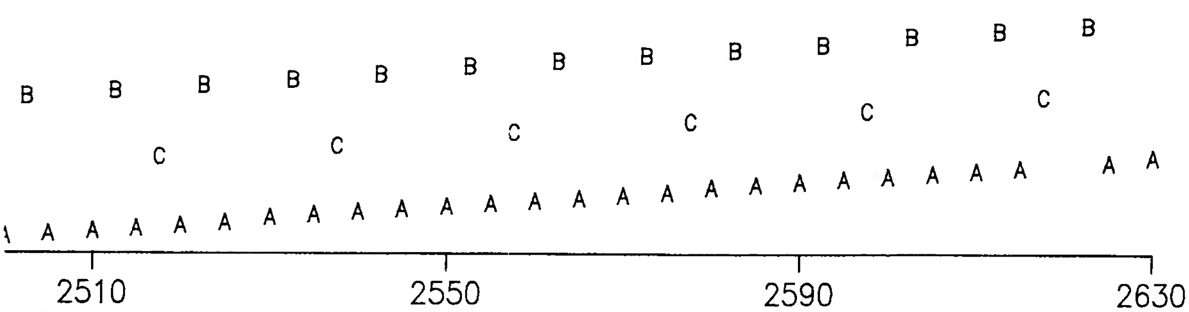


STATION

CENTER LINE



STATION



dam axis

C - **Center line of grout holes**

D - **Holes used to address anomalous conditions and to extend the grout curtain at the upper left abutment**

LITTLE DE

SALT LAKE CITY

FOUNDATION GF

GROUT TAKE VE

STATION 24+3

CORPS OF ENGINE

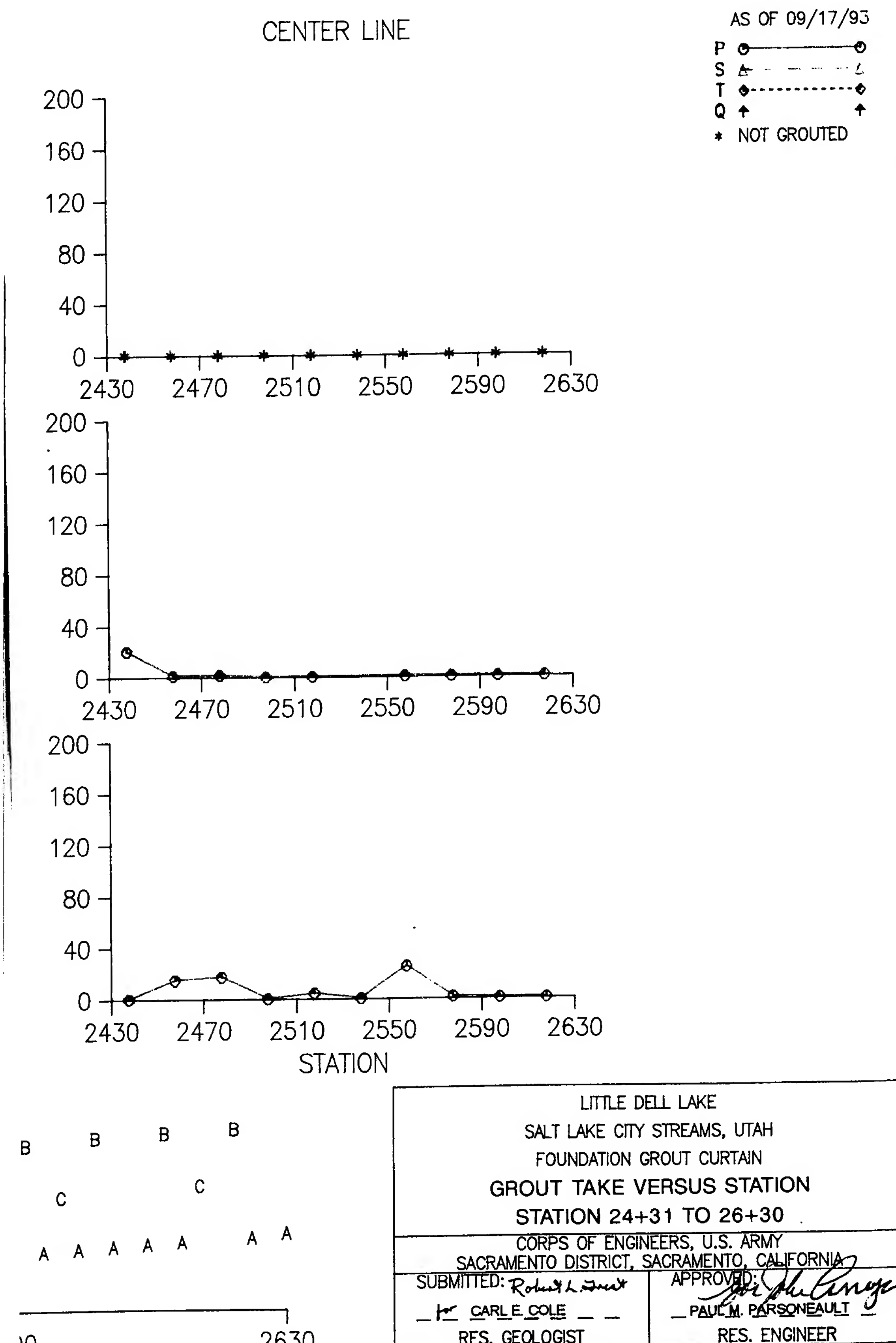
SACRAMENTO DISTRICT, SA

SUBMITTED: Robert L. [illegible]

for CARL E. COLE

RES. GEOLOGIST

PLOTTED BY:	CHECKED BY:	GEOL. BY:



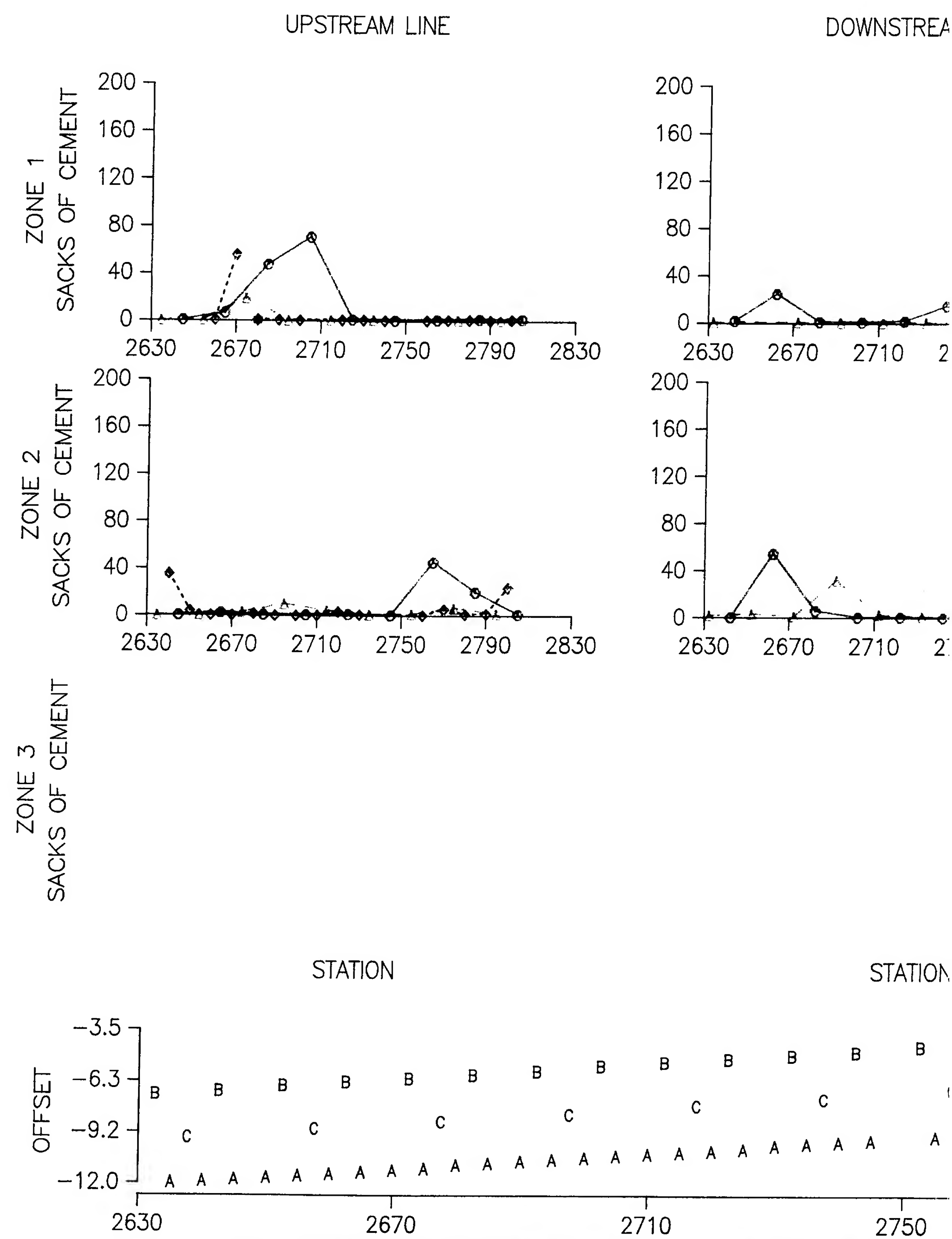
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION
STATION 24+31 TO 26+30

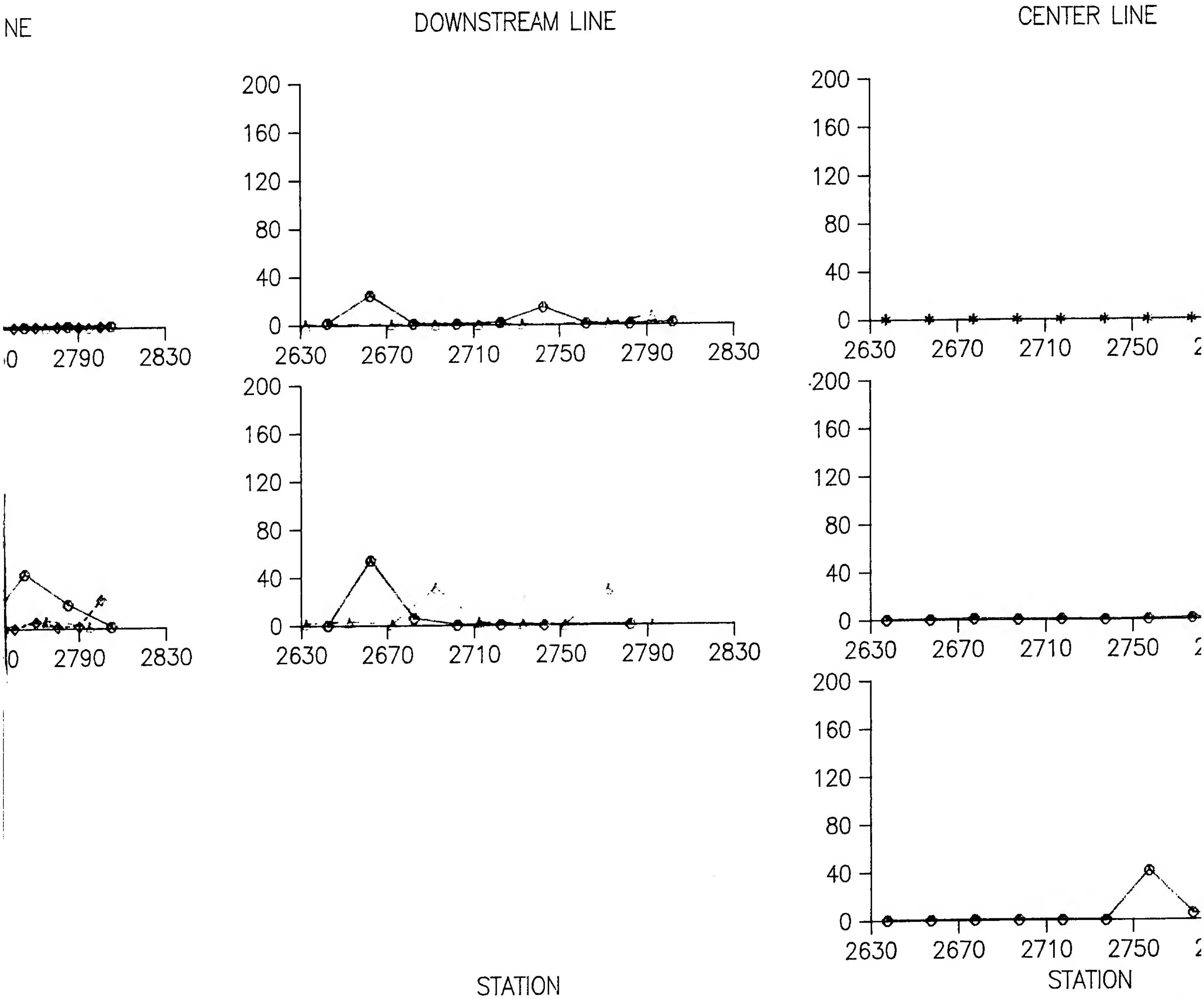
CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

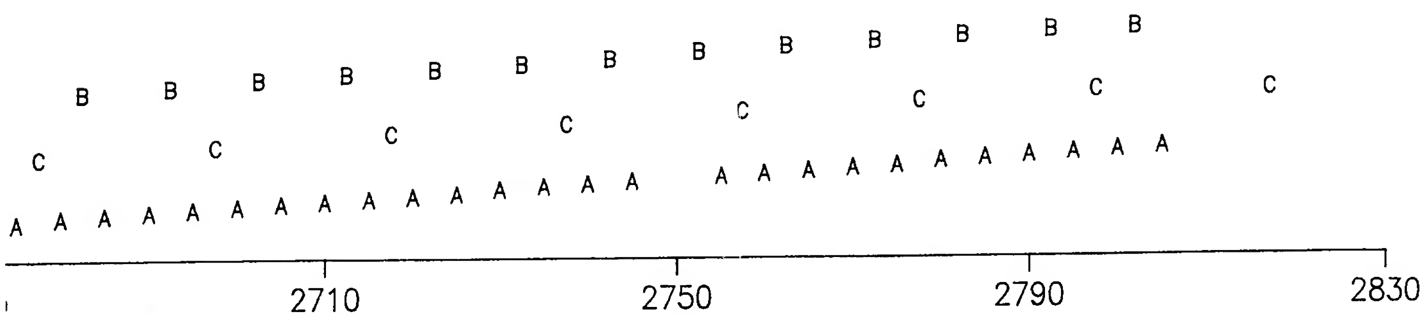
SUBMITTED:	APPROVED:
for CARL E. COLE	PAUL M. PARSONEAULT
RES. GEOLOGIST	RES. ENGINEER

PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO
			PLATE 81



Note: Offsets shown are in feet, upstream from dam axis
A - Upstream line of grout holes
B - Downstream line of grout holes
C - Center line of grout holes
D - Holes used to address anomaious
extend the grout curtain at the u

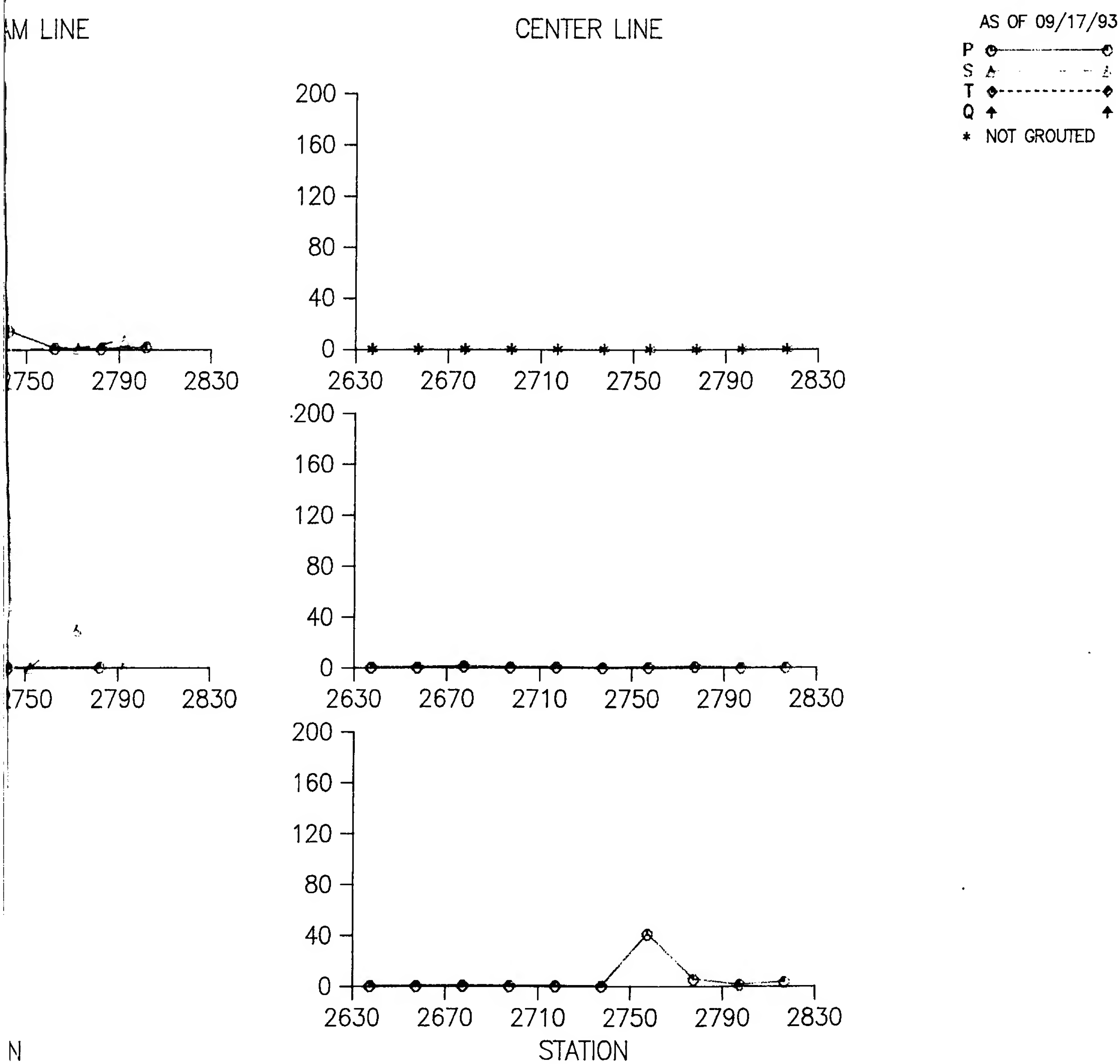


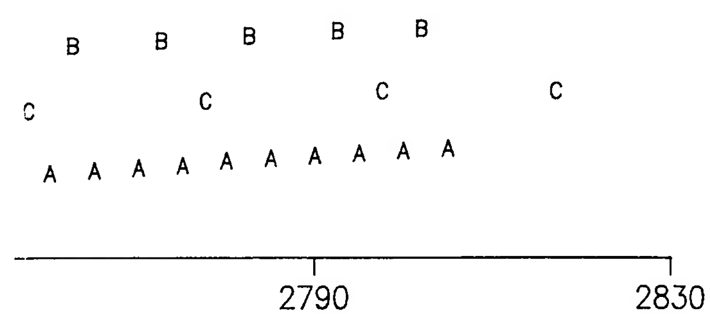


: in feet, upstream from dam axis
ne of grout holes
line of grout holes

C - Center line of grout holes
D - Holes used to address anomaious conditions and to extend the grout curtain at the upper left abutment

SUBMI
PLOTTED BY:





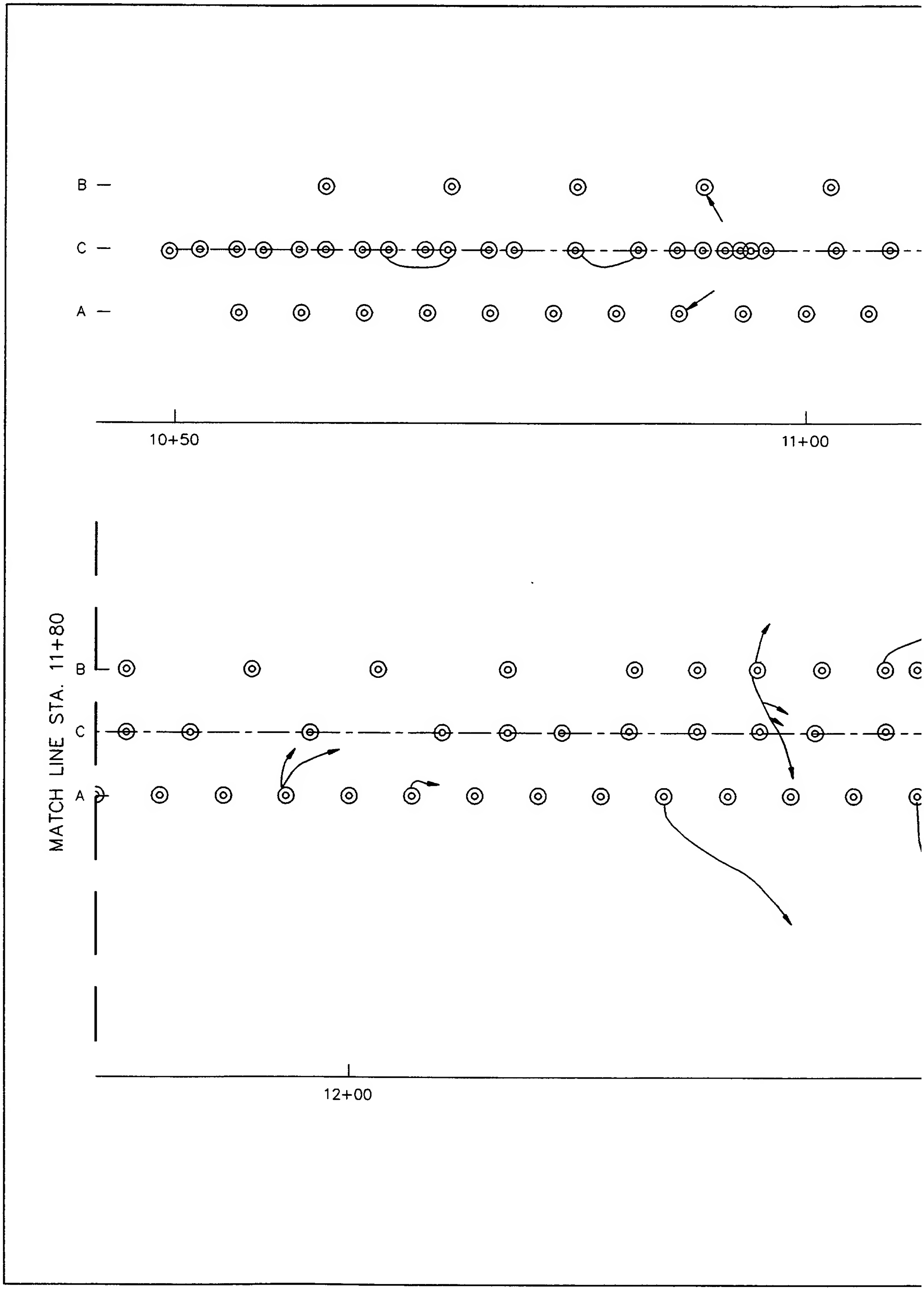
us conditions and to
upper left abutment

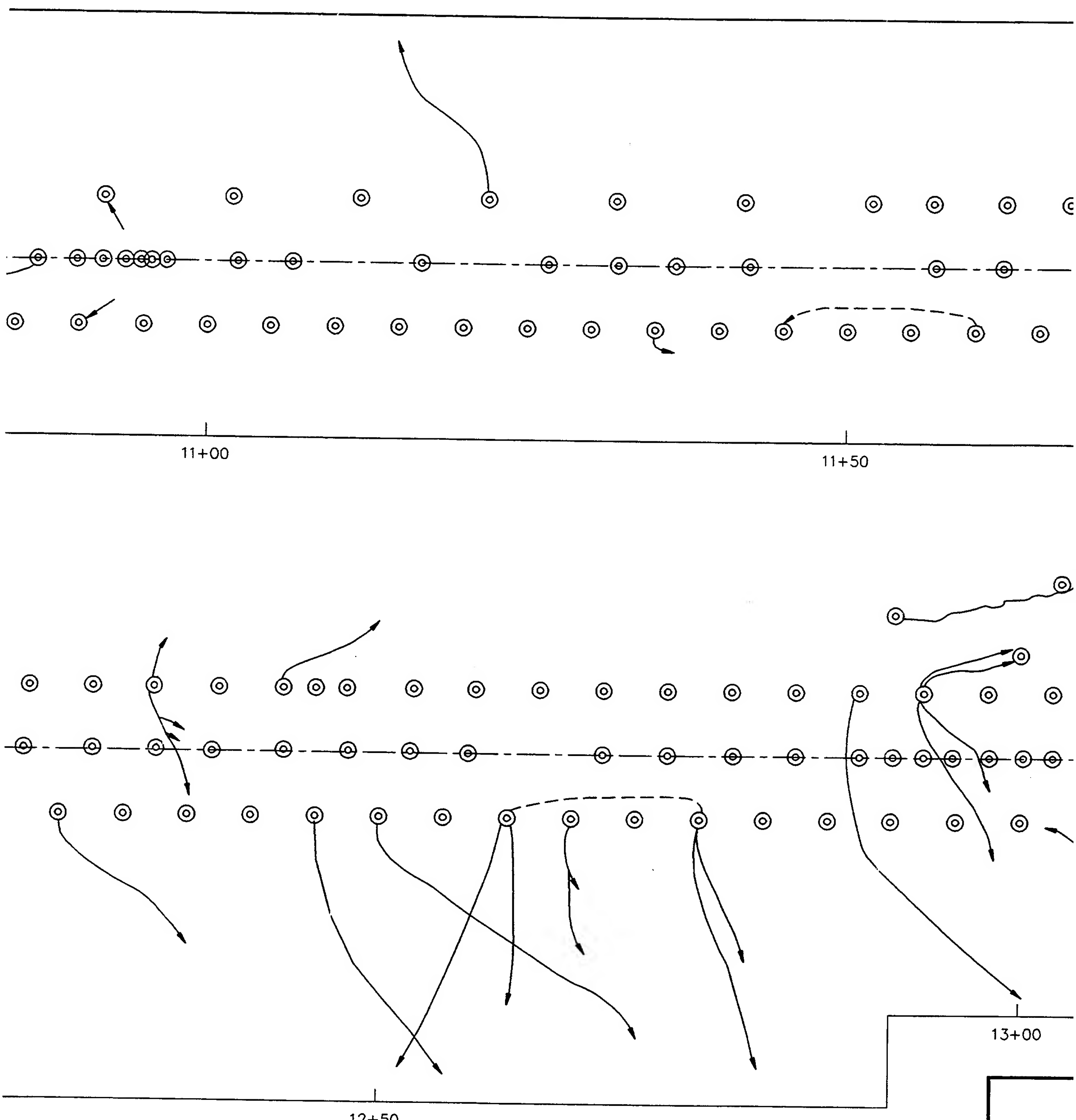
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
FOUNDATION GROUT CURTAIN

GROUT TAKE VERSUS STATION
STATION 26+31 TO 28+17

CORPS OF ENGINEERS, U.S. ARMY
SACRAMENTO DISTRICT, SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE RES. GEOLOGIST			APPROVED: for John Carrigan PAUL M. PARSONEAULT RES. ENGINEER
PLOTTED BY:	CHECKED BY:	GEOL. BY:	FILE NO. PLATE 82


B
C
A
10+50
11+00
MATCH LINE STA. 11+80
B
C
A
12+00



LEGEND:

DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

GRAPHIC SCALE:

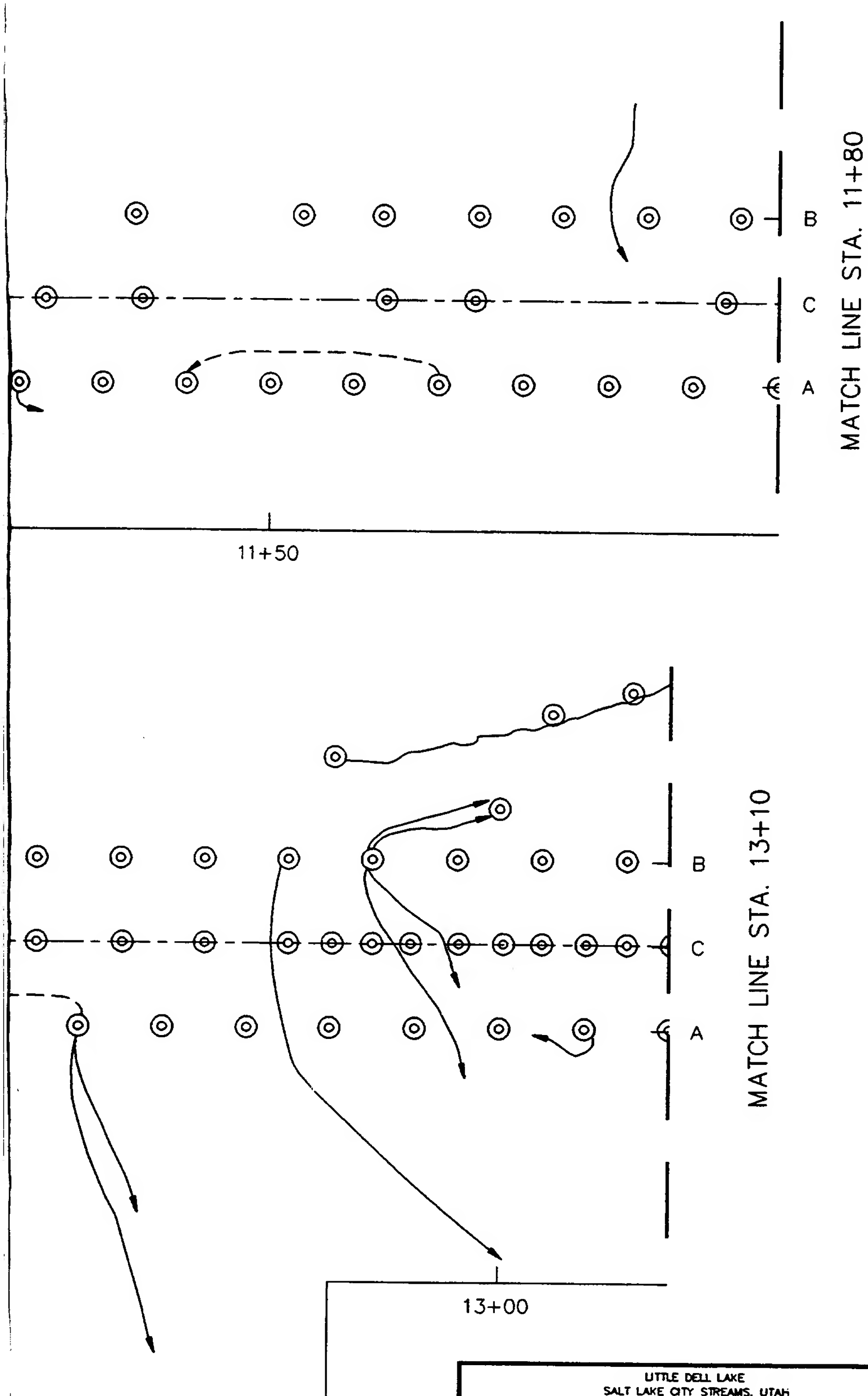
0 10' 20'

(SCALE IN FEET)

SUBMITTED:

CARL E

ERE



LEGEND:

DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

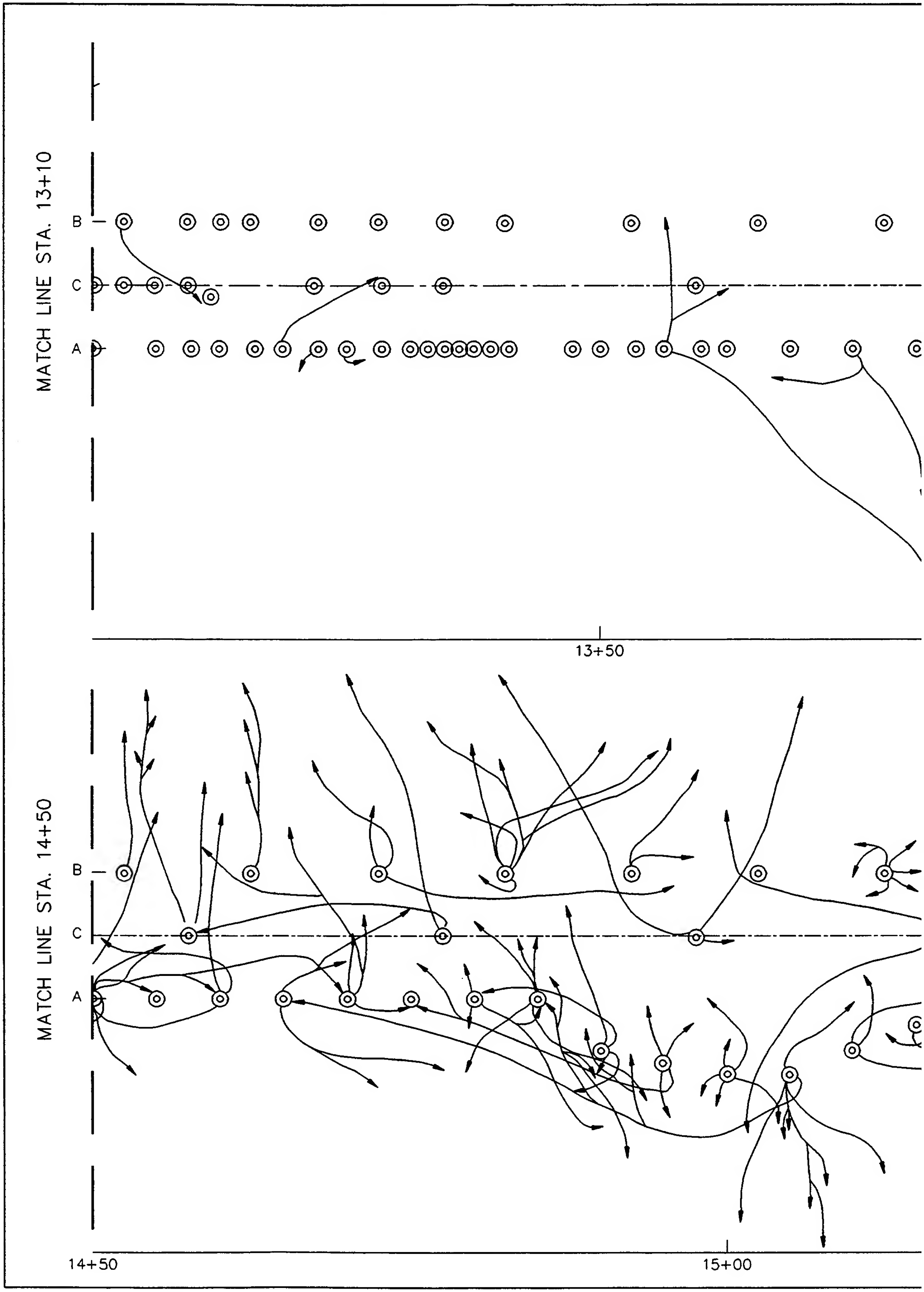
MAIN DAM

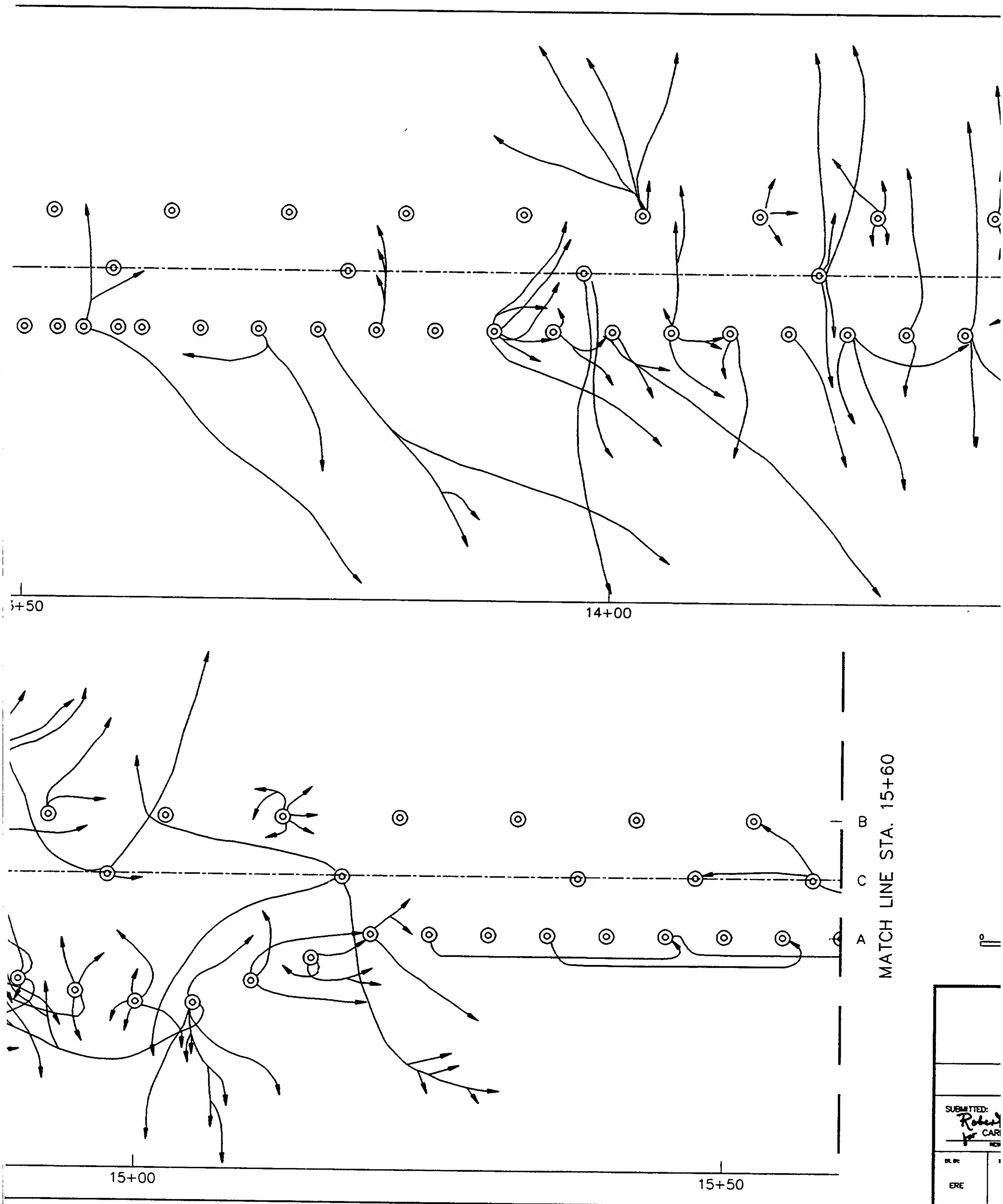
CORE TRENCH GROUTING
STA. 10+50 TO STA. 13+10

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

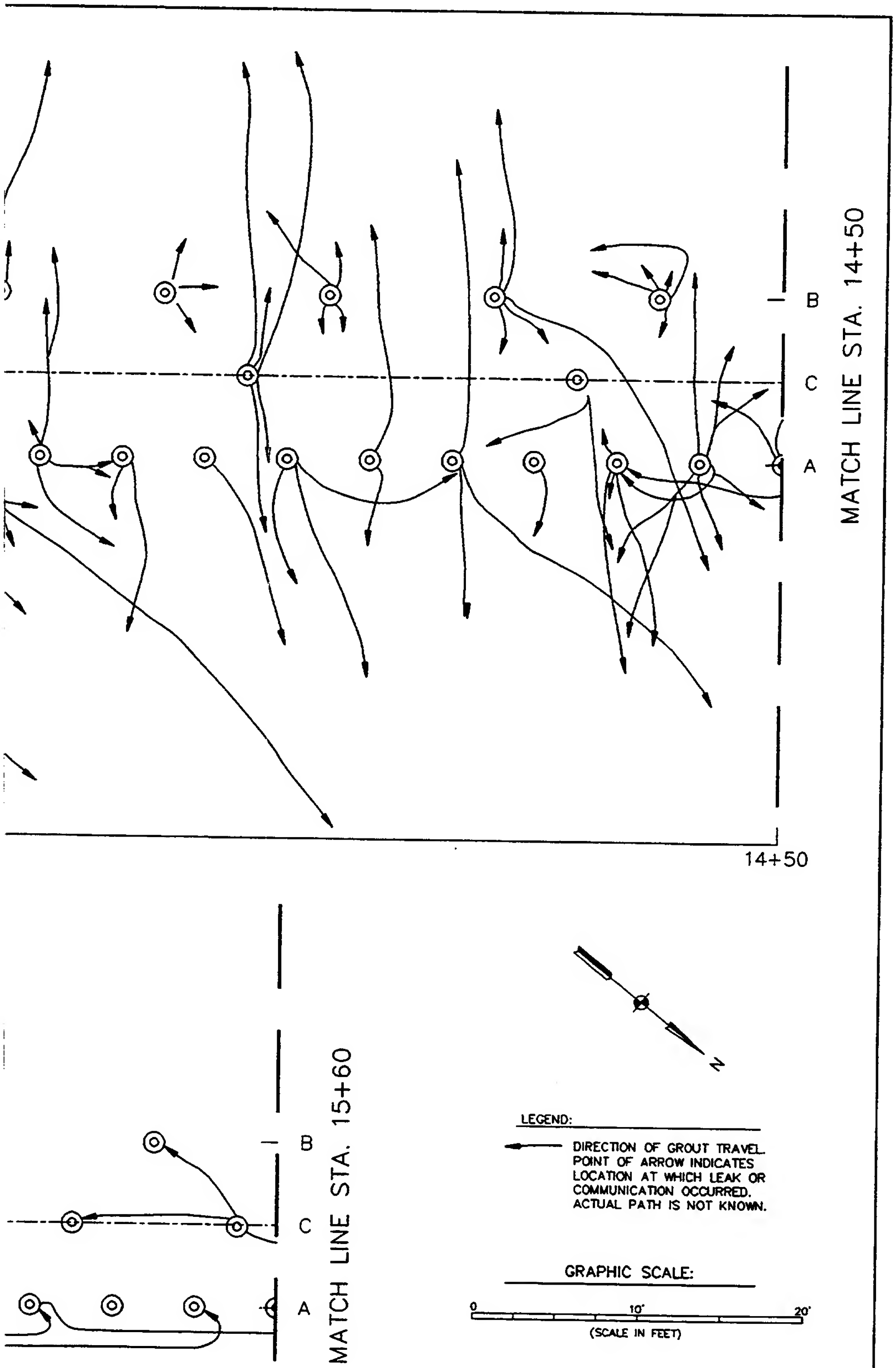
SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE		BAB	PLATE 83


MATCH LINE STA. 13+10
B
C
A
13+50
MATCH LINE STA. 14+50
B
C
A
14+50
15+00



+50
14+00
B
C
A
MATCH LINE STA. 15+60
15+00
15+50
SUBMITTED:
CAR
ERE



LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

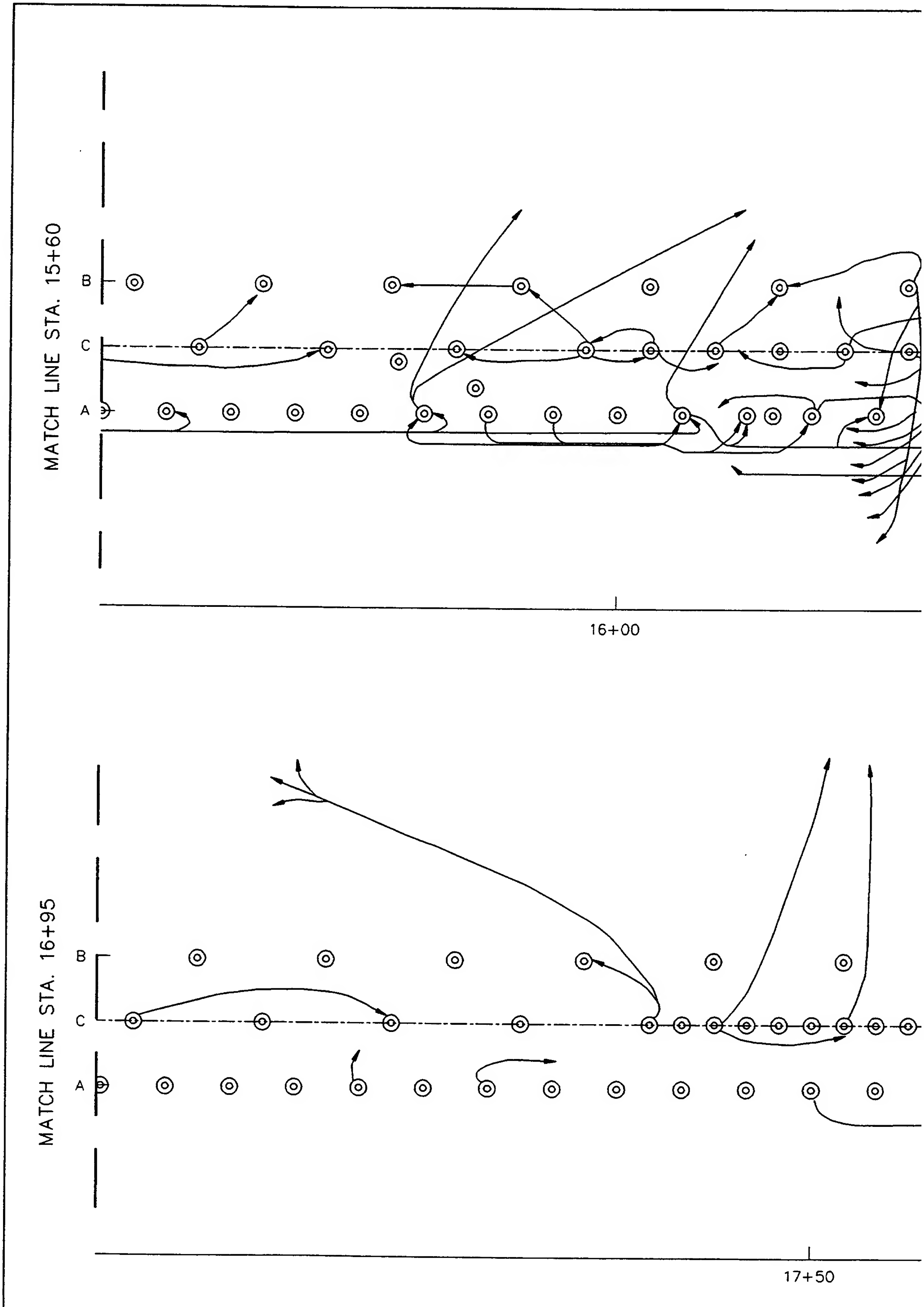
CORE TRENCH GROUTING
STA. 13+10 TO STA. 15+60

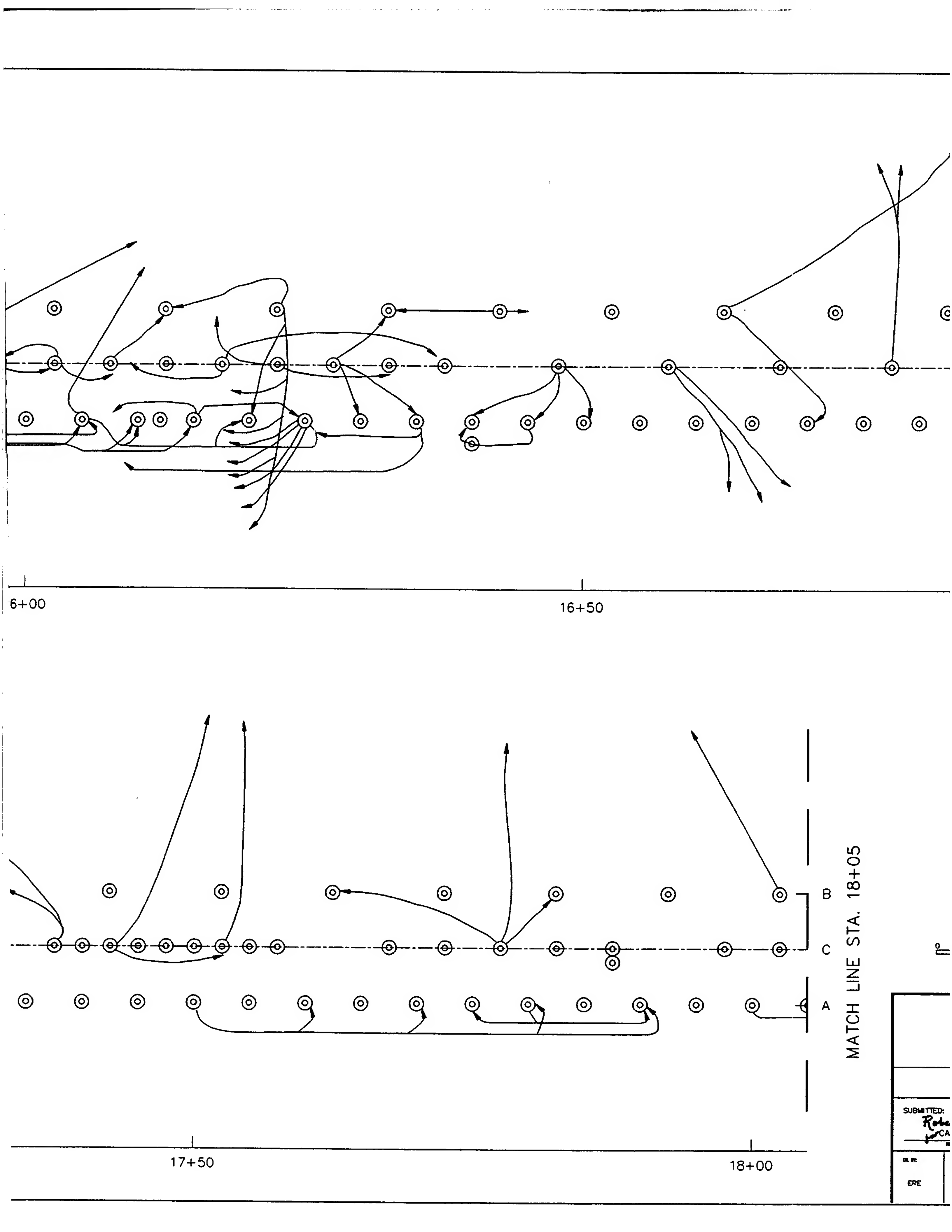
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

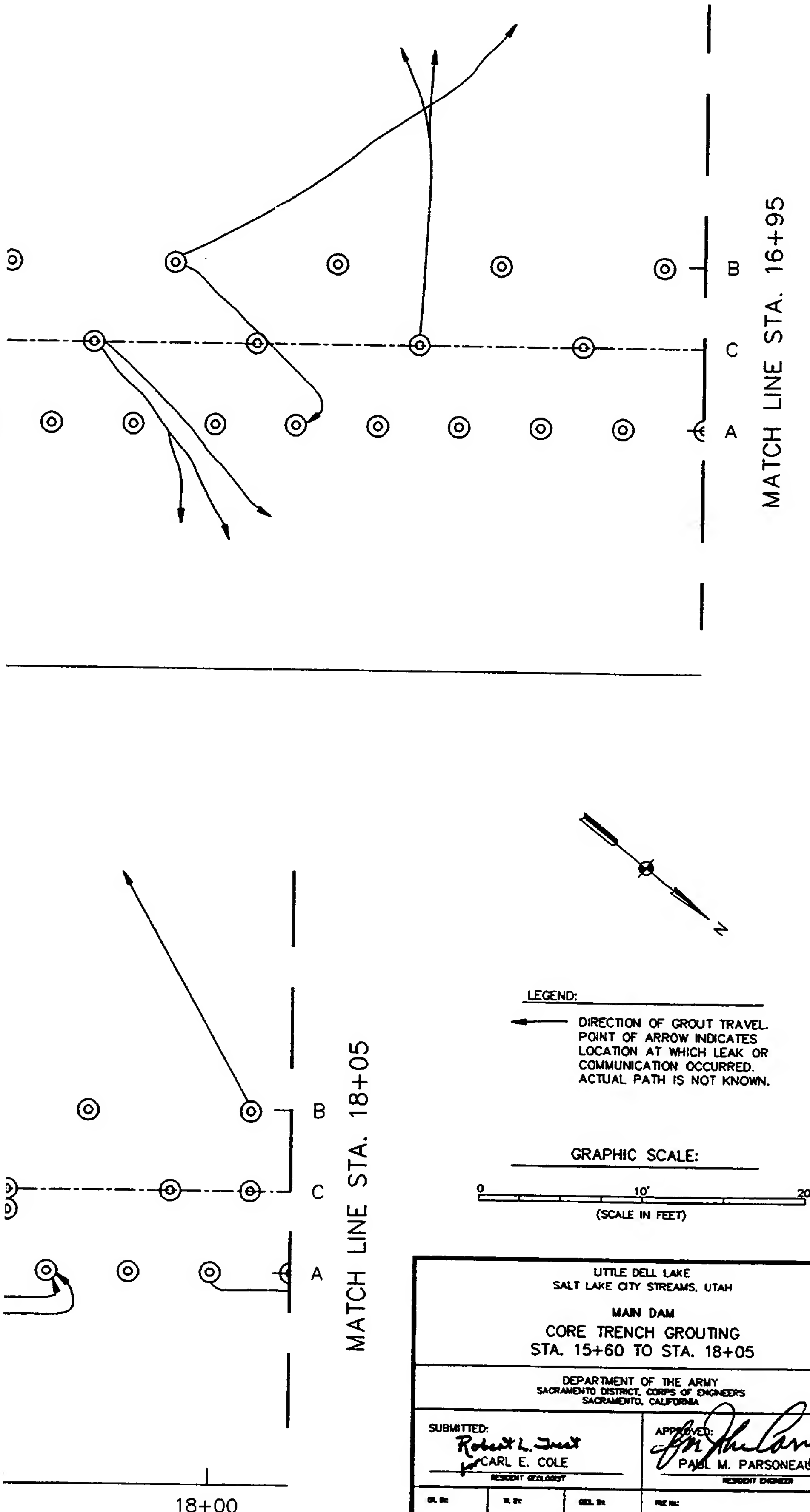
SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: for John Carnegie PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE No.:
ERE		BAB	PLATE 84


MATCH LINE STA. 15+60
B
C
A
16+00
MATCH LINE STA. 16+95
B
C
A
17+50


6+00
16+50
17+50
18+00
B
C
A
MATCH LINE STA. 18+05
SUBMITTED:
ERE



LEGEND:

DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

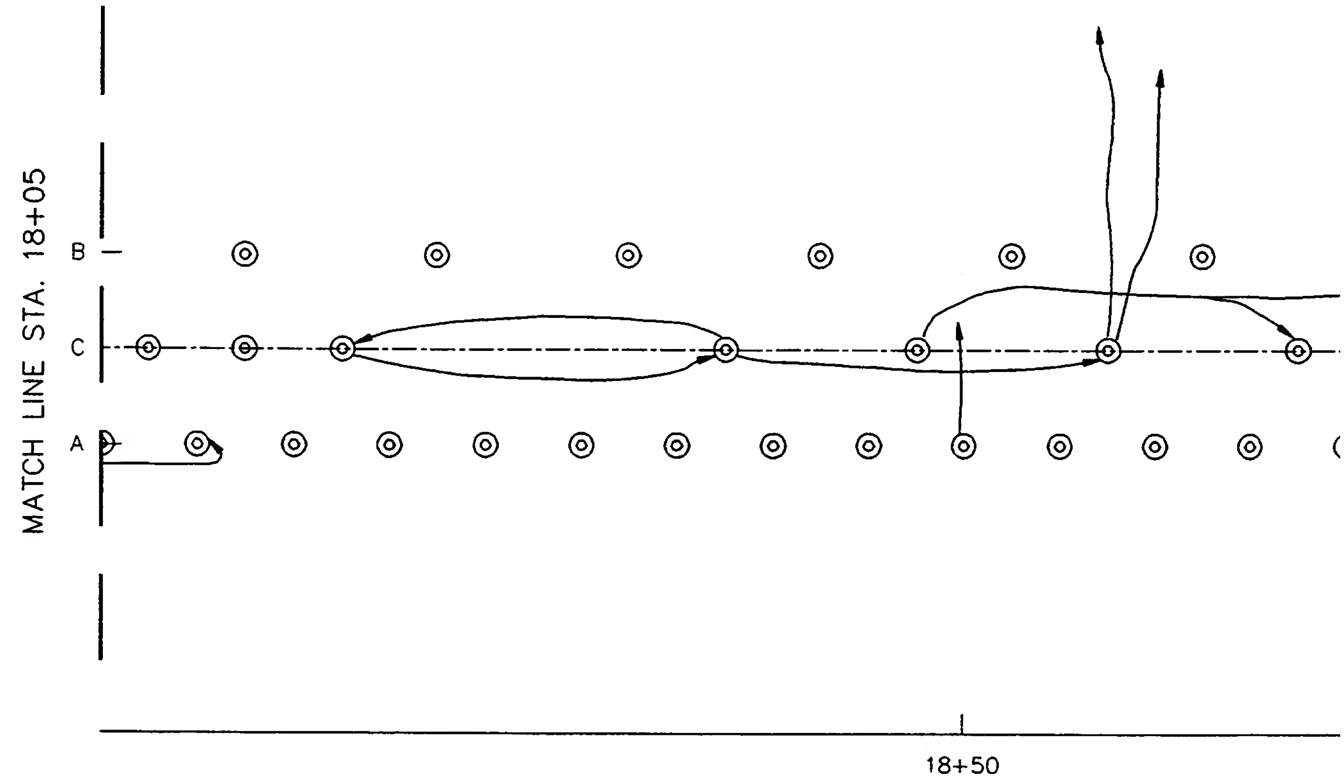
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

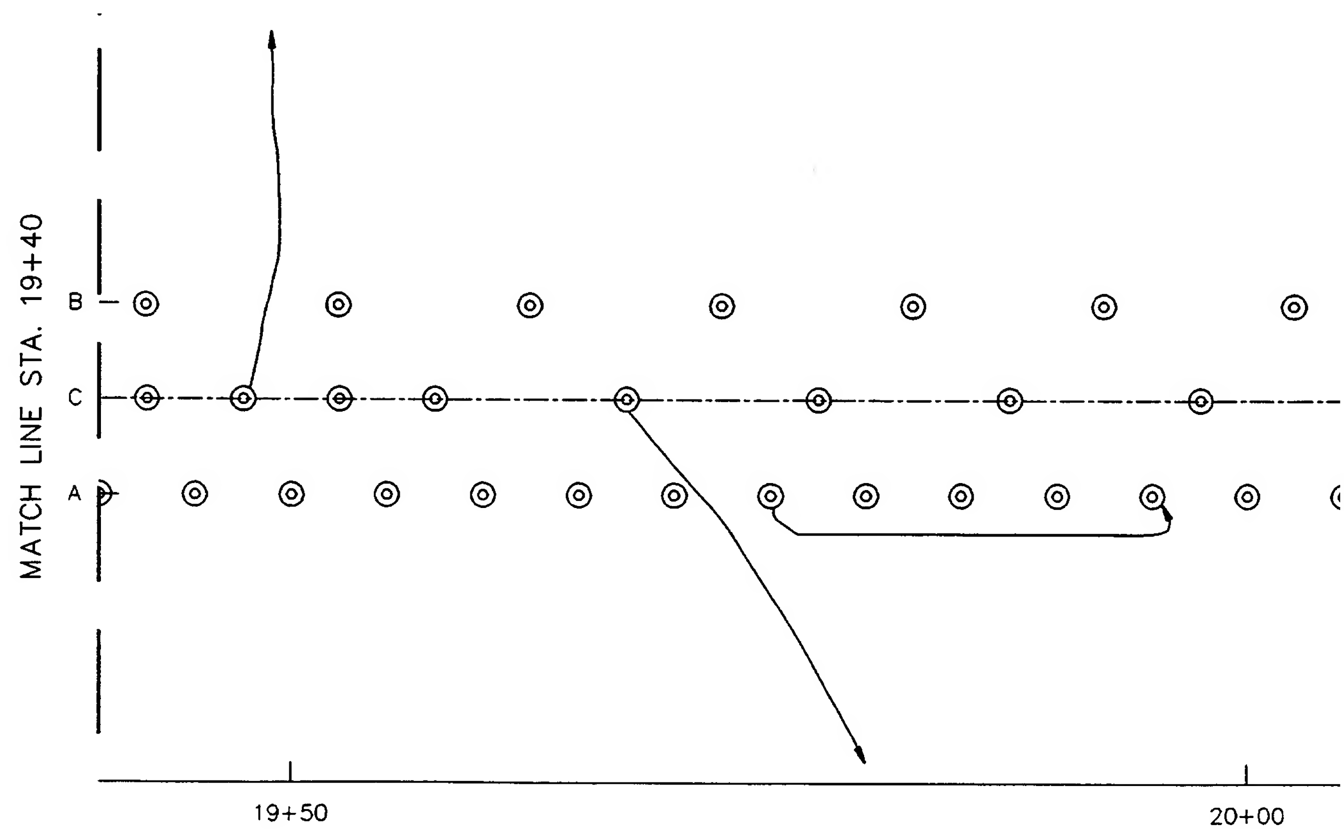
MAIN DAM

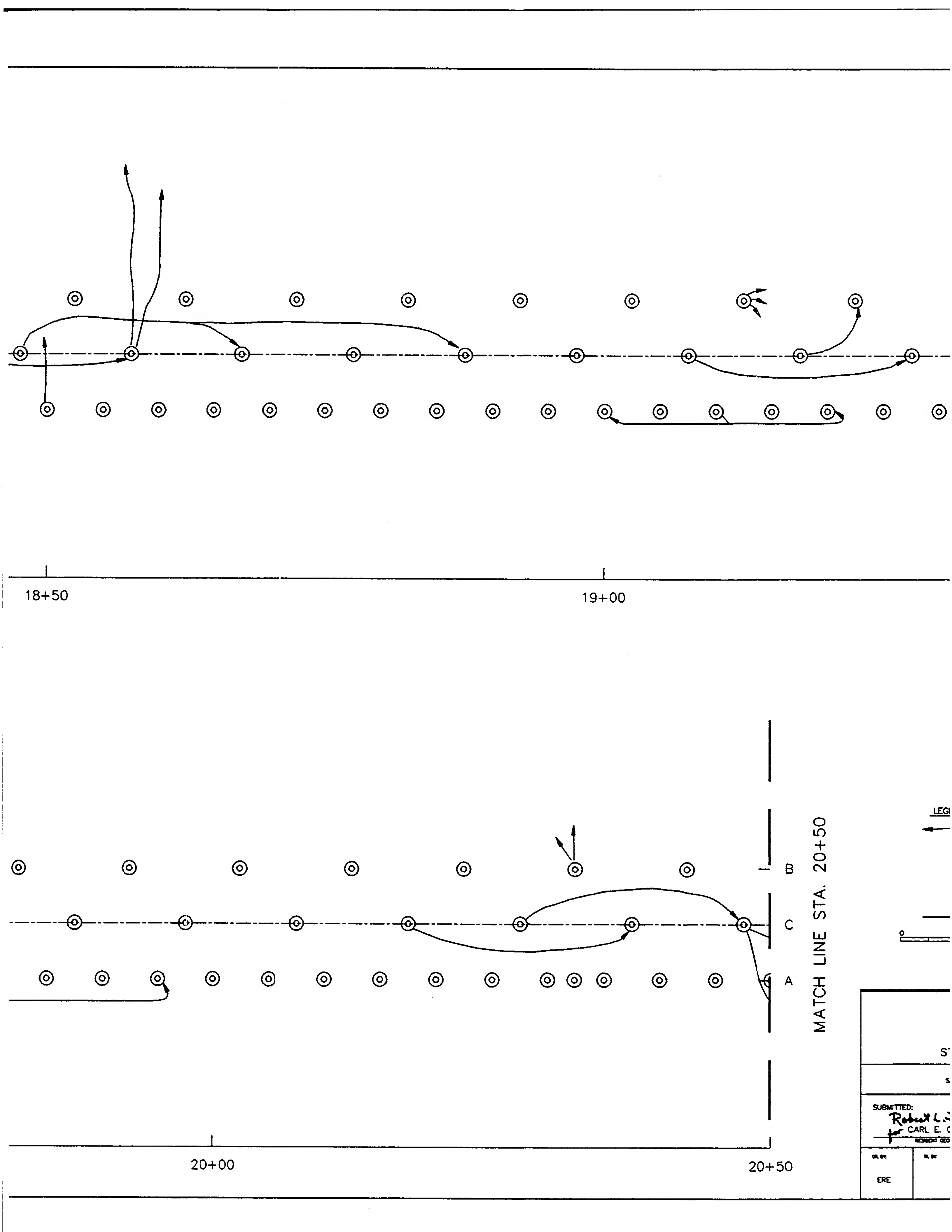
CORE TRENCH GROUTING
STA. 15+60 TO STA. 18+05

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

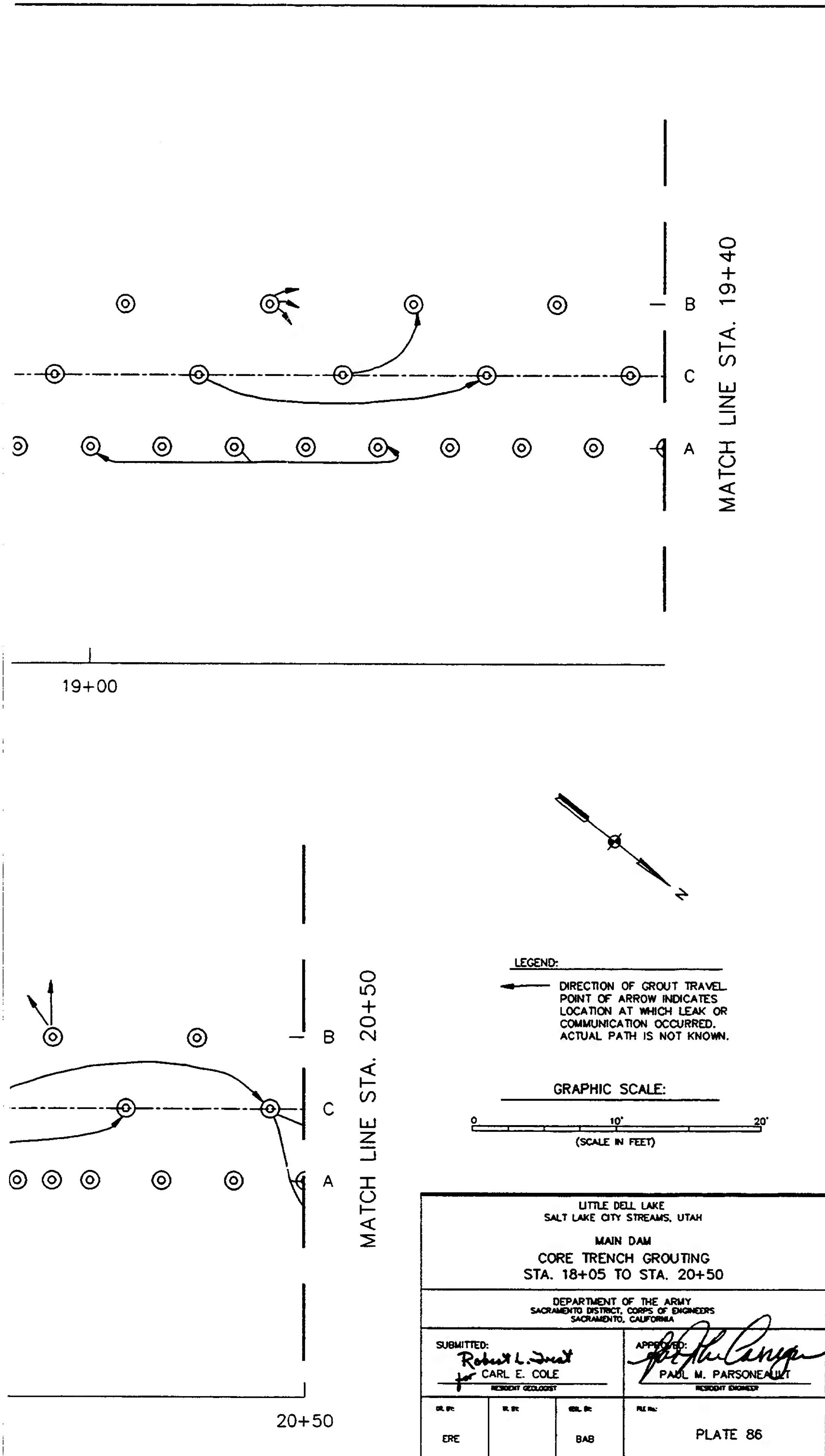
SUBMITTED: Robert L. Trent for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	CK. BY:	GEOL. BY: BAB	FILE No.: PLATE 85


MATCH LINE STA. 18+05
B
C
A
18+50


MATCH LINE STA. 19+40
B
C
A
19+50
20+00



18+50
19+00
B
C
A
MATCH LINE STA. 20+50
20+00
20+50
SUBMITTED:
CARL E.
ERE



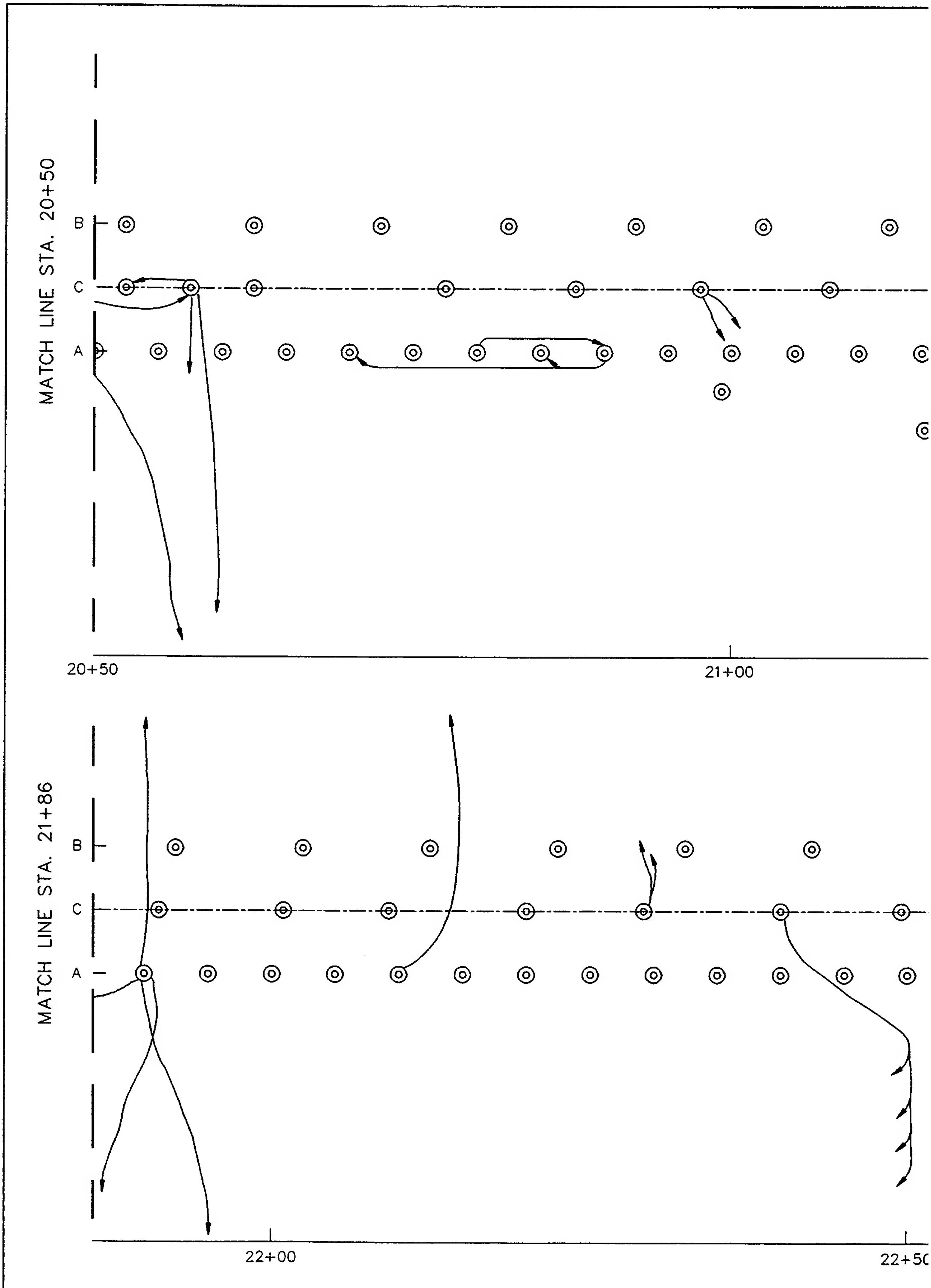
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

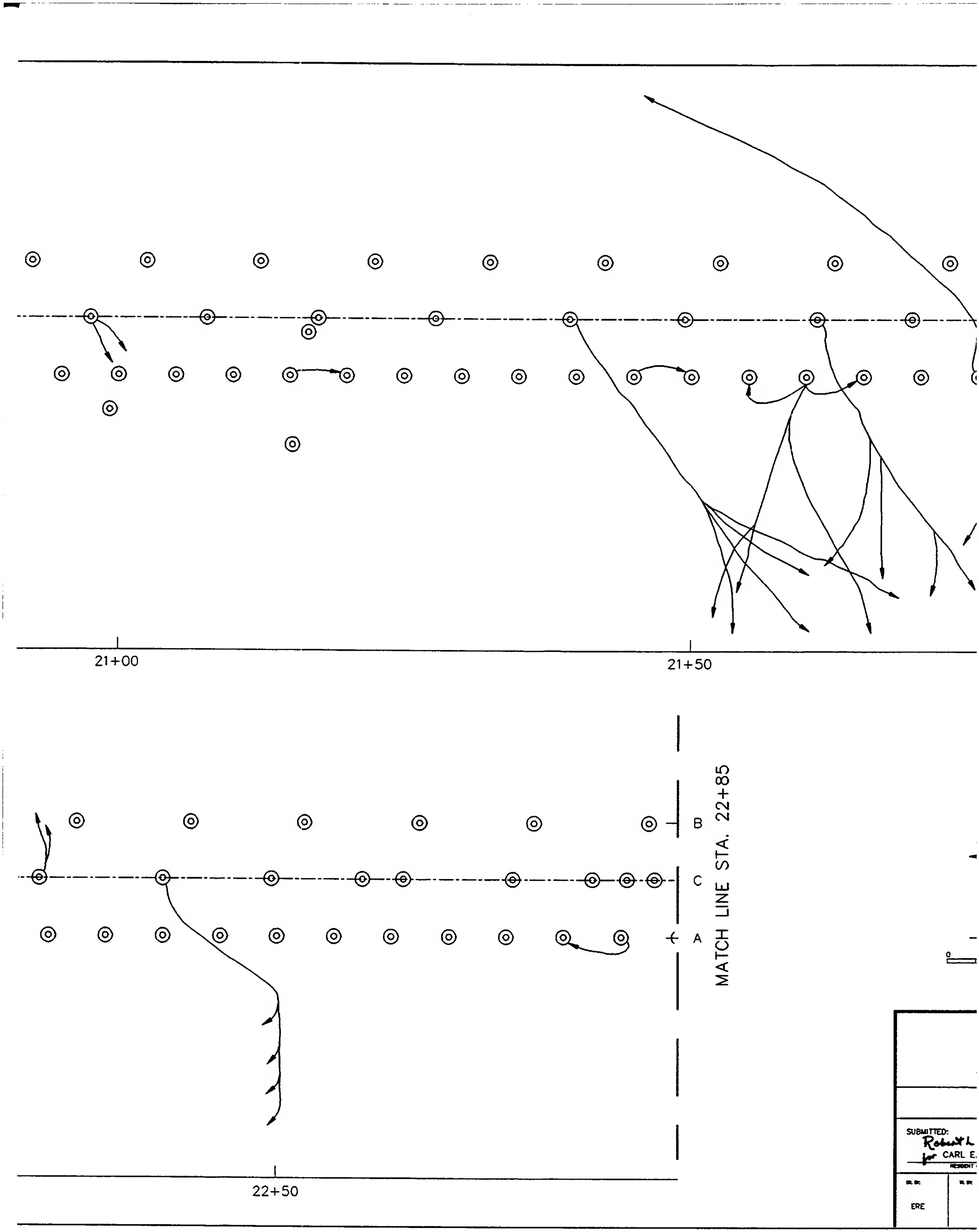
MAIN DAM
CORE TRENCH GROUTING
STA. 18+05 TO STA. 20+50

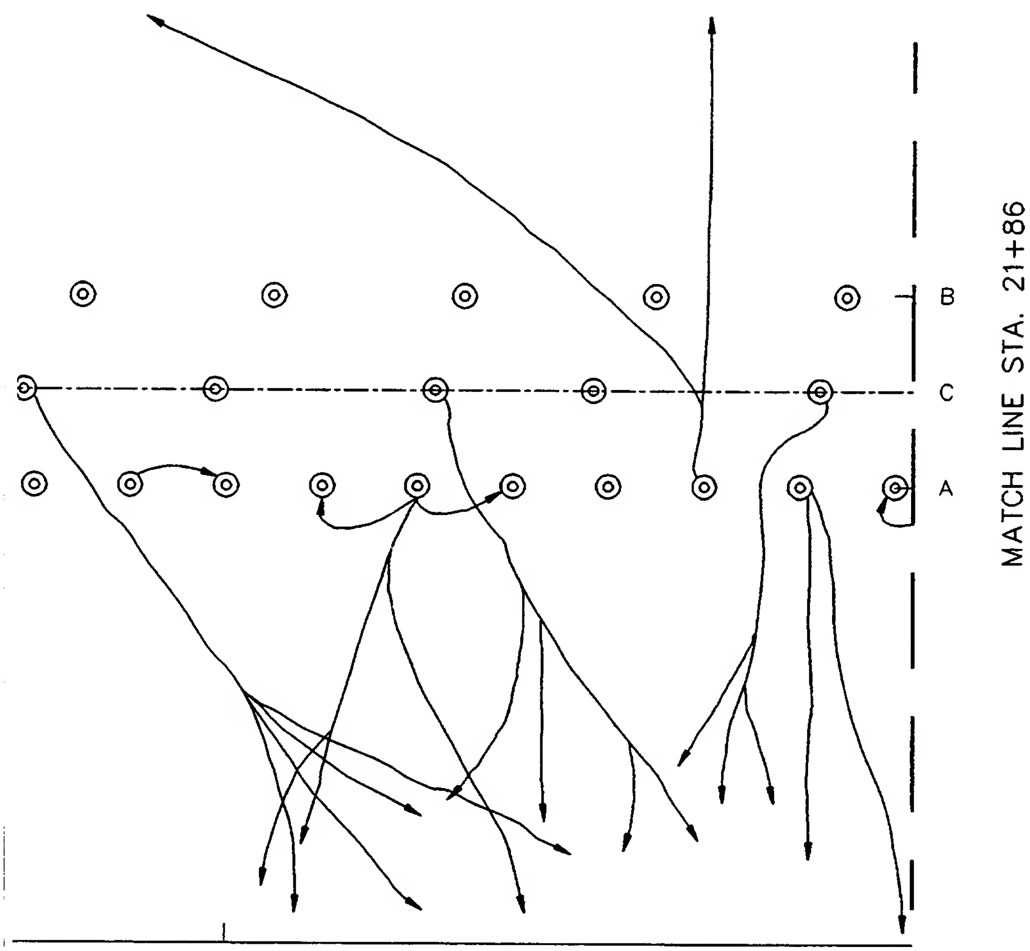
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

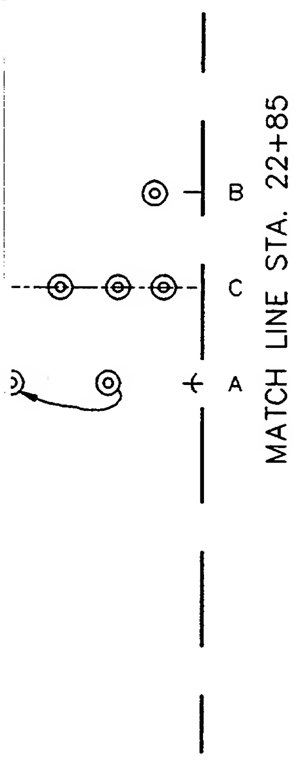
SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	CK. BY: BAB

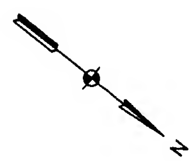
PLATE 86


MATCH LINE STA. 20+50
B
C
A
20+50
21+00
MATCH LINE STA. 21+86
B
C
A
22+00
22+50


21+00
21+50
B
C
A
MATCH LINE STA. 22+85
22+50
SUBMITTED:
CARL E.
ERE







LEGEND:

DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

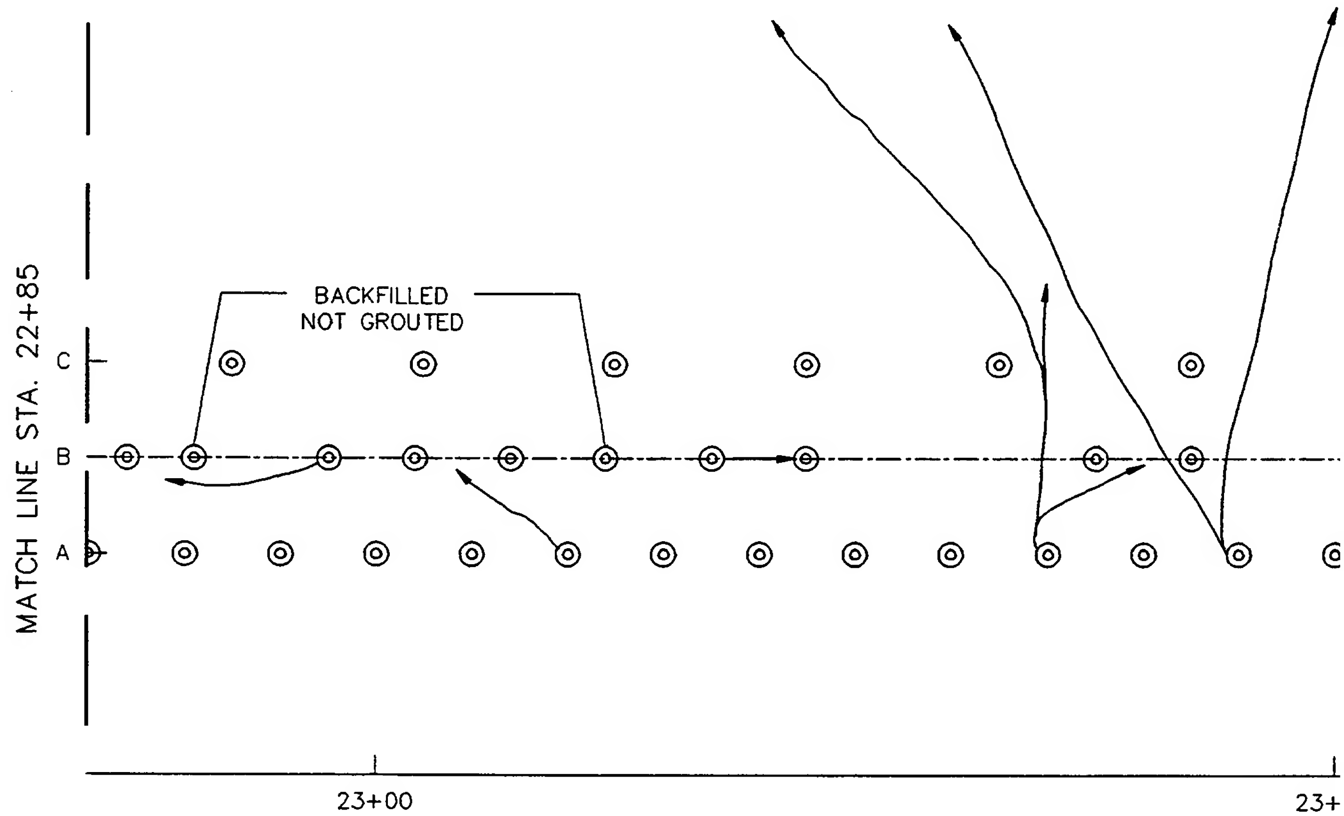
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

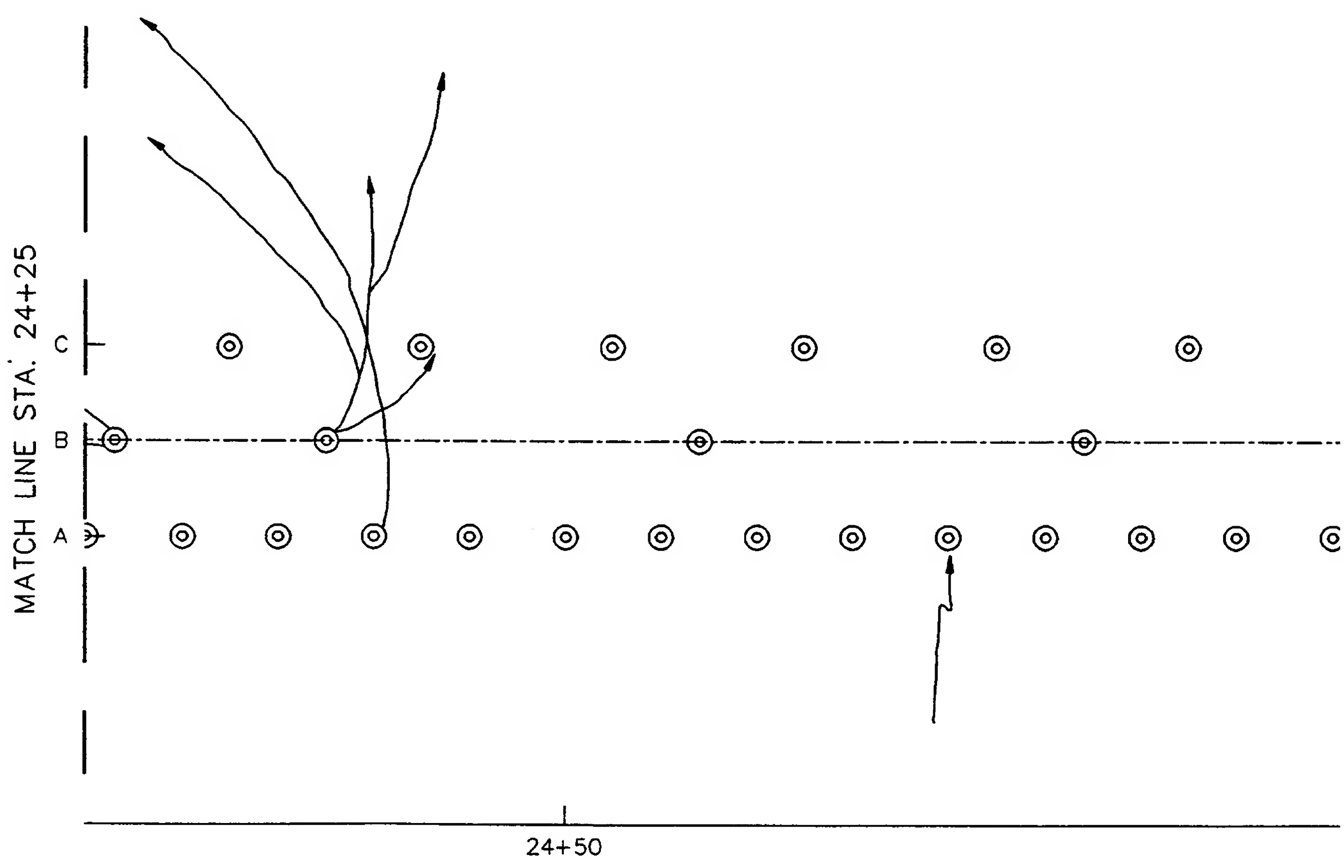
MAIN DAM

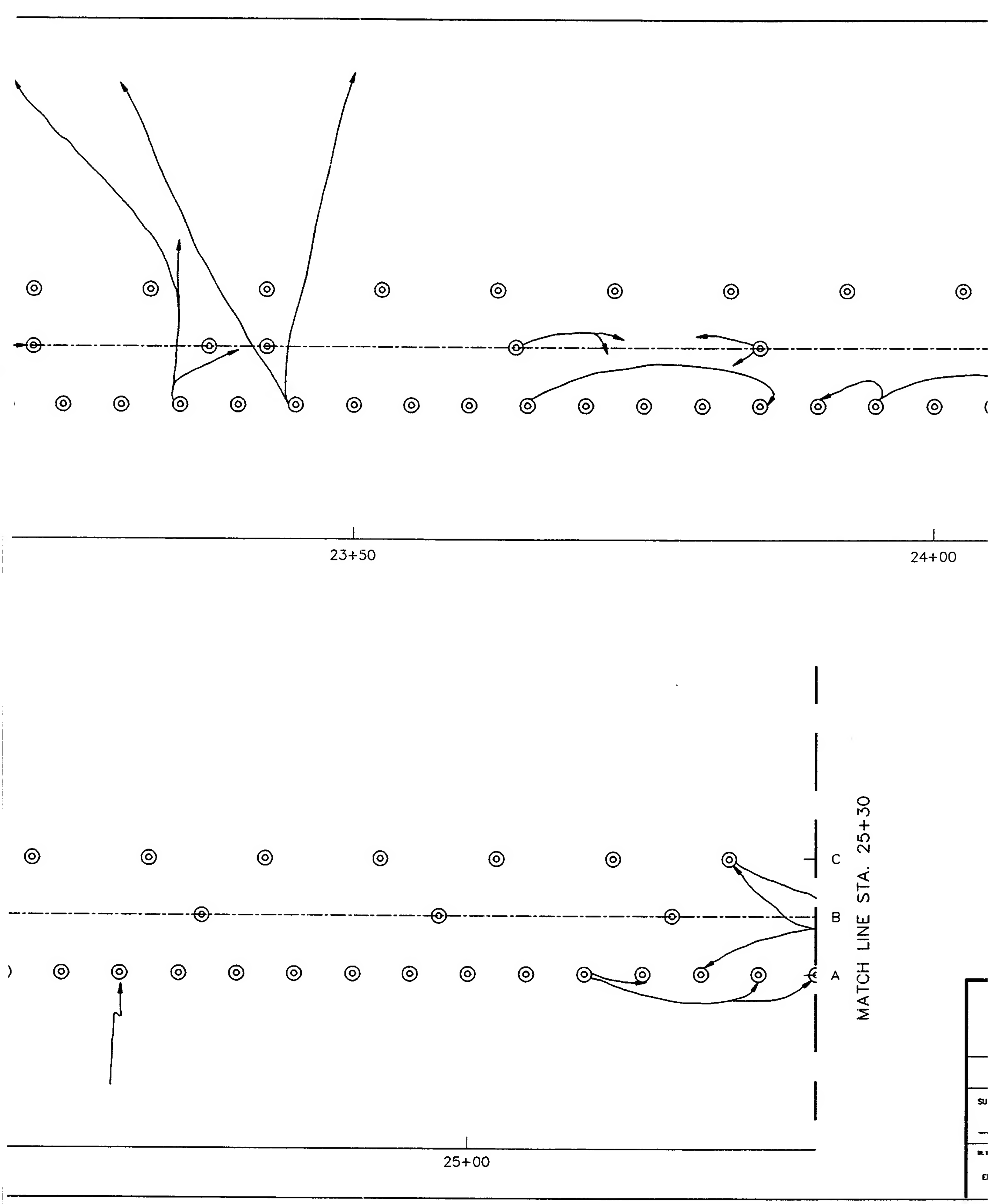
CORE TRENCH GROUTING
STA. 20+50 TO STA. 22+85

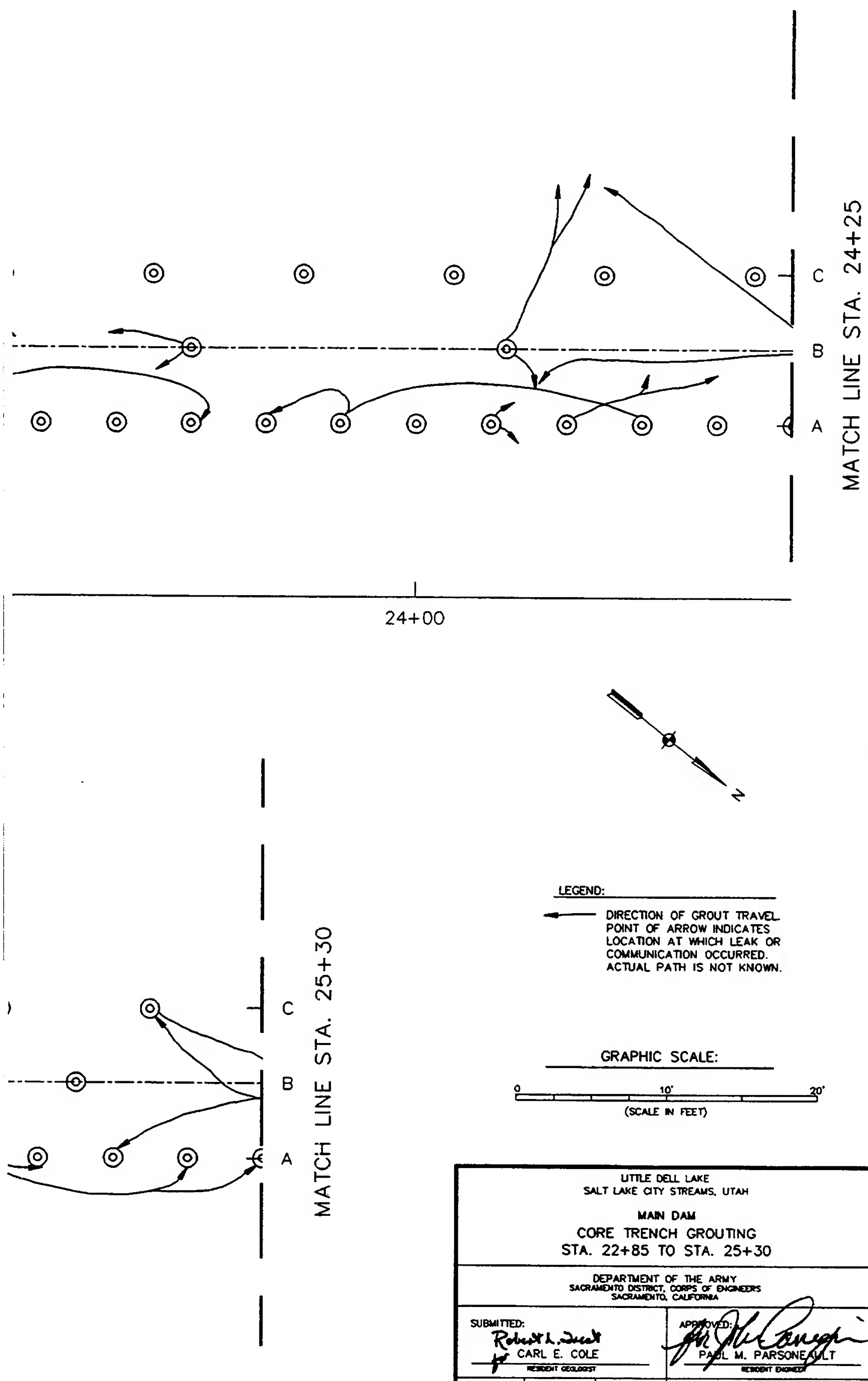
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:			APPROVED:
Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST			PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	TR. BY:	CHK. BY: BAB	FILE NO: PLATE 87


BACKFILLED
NOT GROUTED
MATCH LINE STA. 22+85
C
B
A
23+00
23+


MATCH LINE STA. 24+25
C
B
A
24+50


23+50
24+00
C
B
A
MATCH LINE STA. 25+30
25+00



LEGEND:

DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

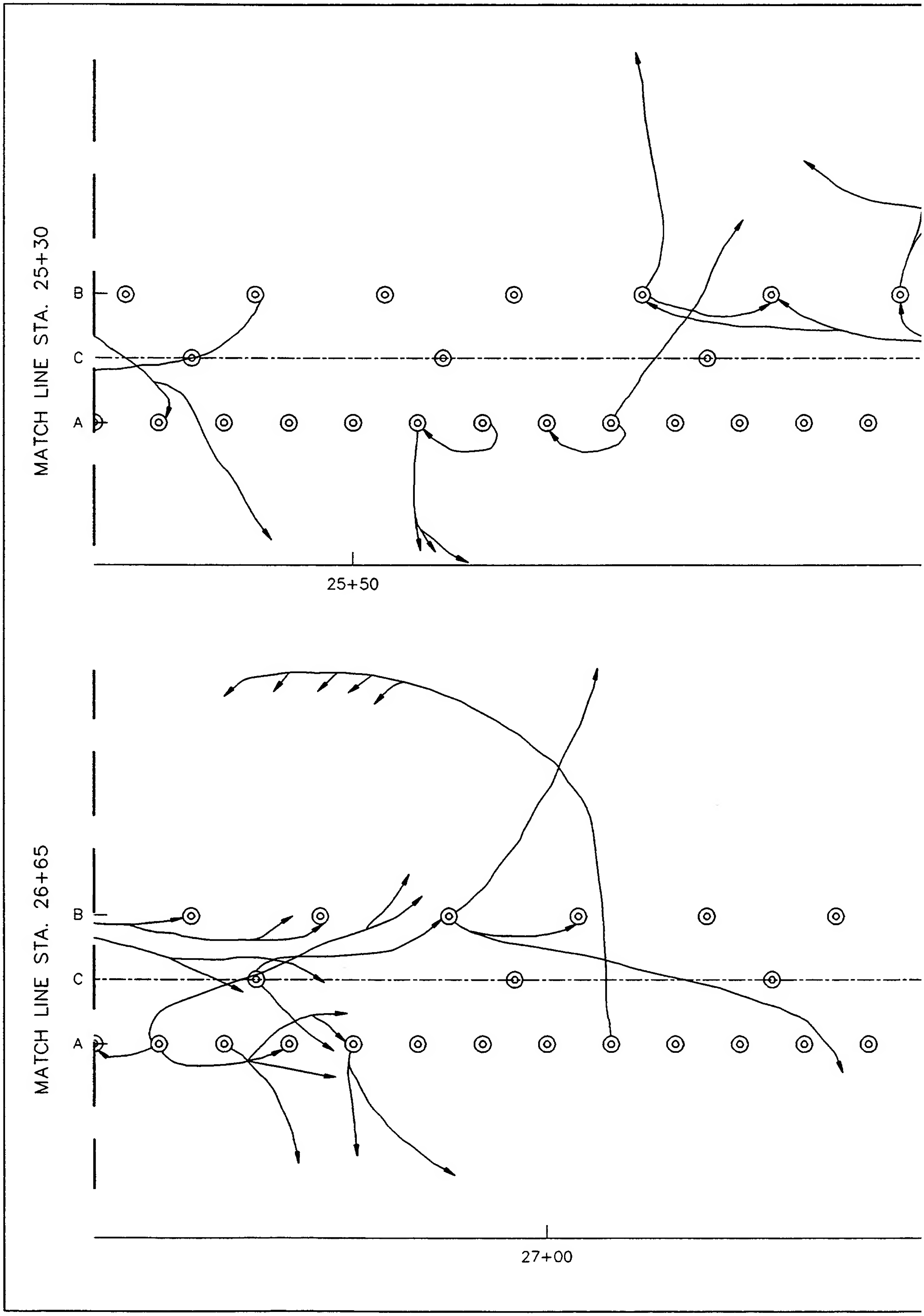
MAIN DAM

CORE TRENCH GROUTING
STA. 22+85 TO STA. 25+30

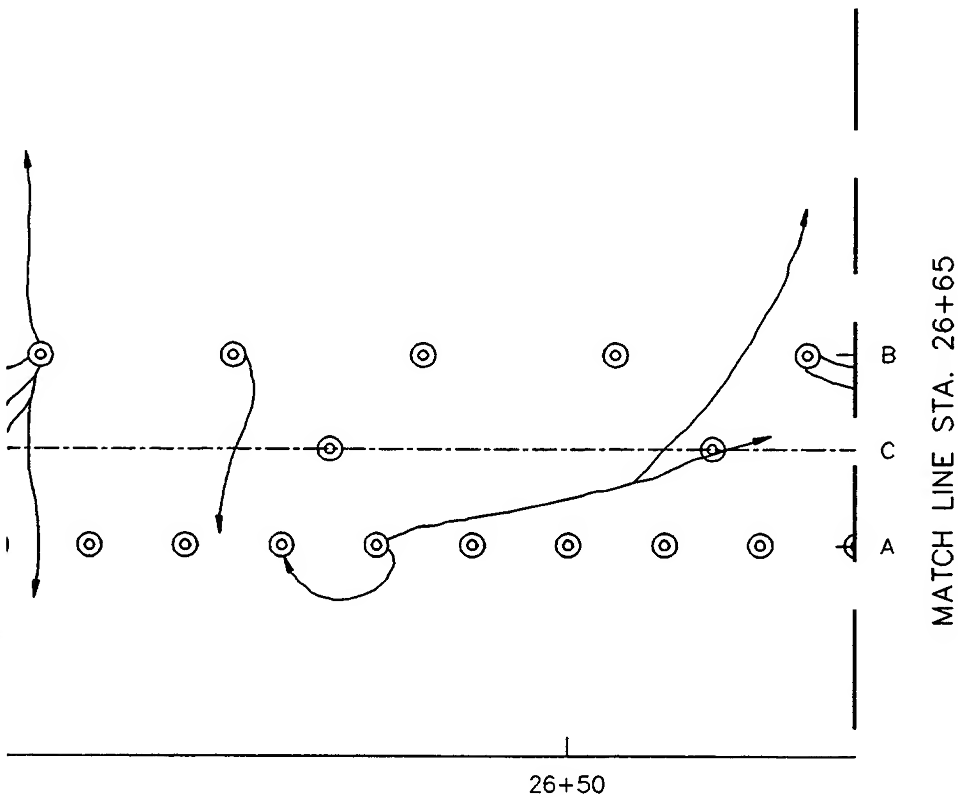
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

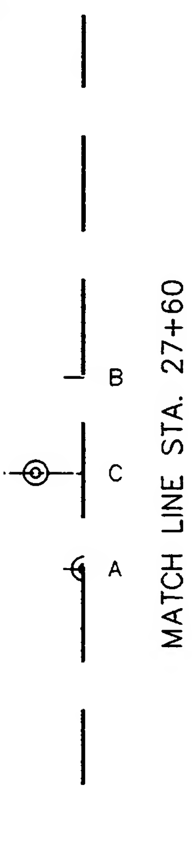
SUBMITTED:	APPROVED:
Robert L. [illegible] for CARL E. COLE, RESIDENT GEOLOGIST	for PAUL M. PARSONEAULT, RESIDENT ENGINEER

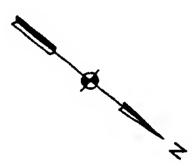
DR. BY:	TR. BY:	CKD. BY:	FILE NO:
ERE		BAB	PLATE 88


MATCH LINE STA. 25+30
B
C
A
25+50
MATCH LINE STA. 26+65
B
C
A
27+00


26+00
26+50
B
C
A
MATCH LINE STA. 27+60
27+50
SUBMITTED:
ERE







LEGEND:

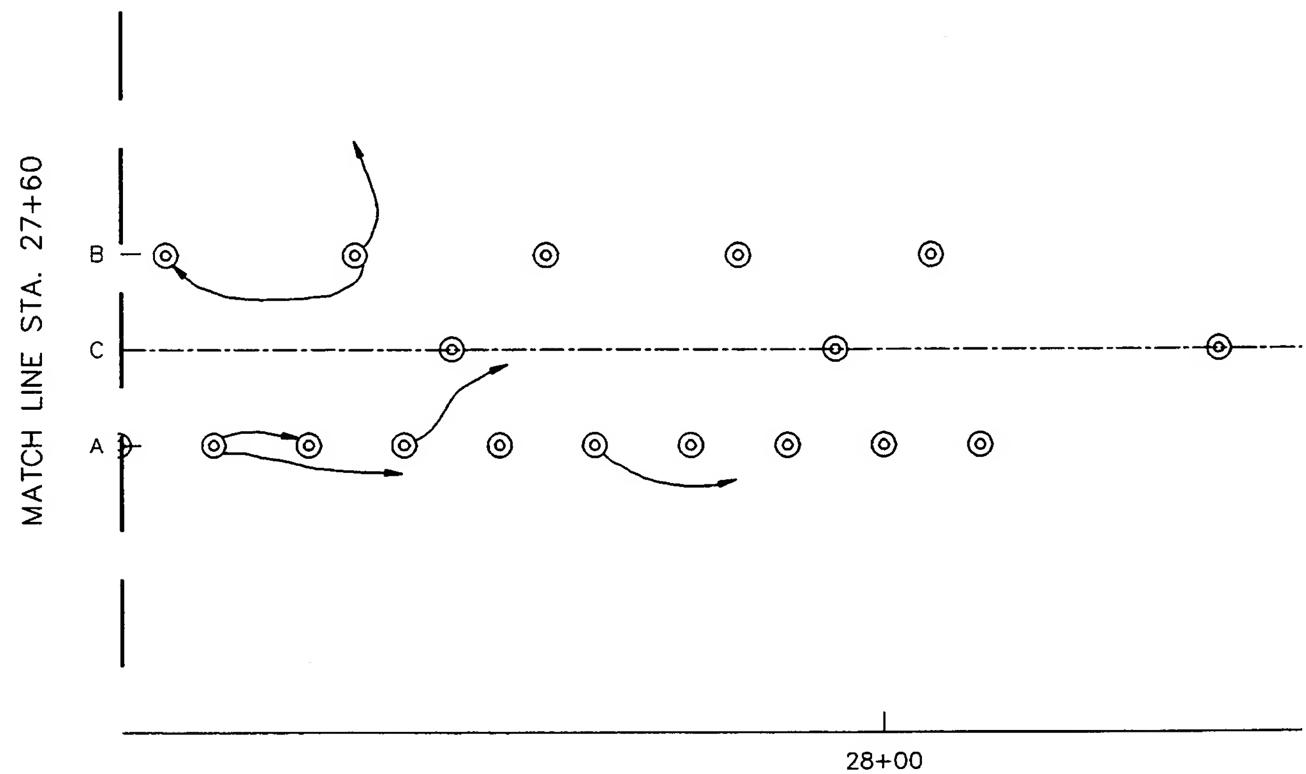
DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

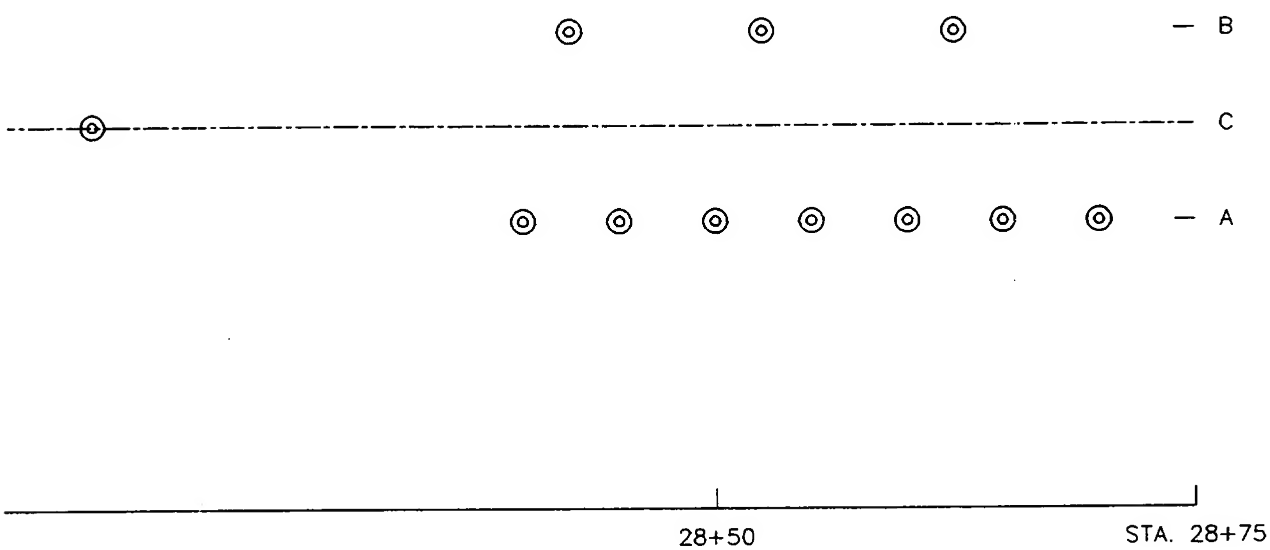
GRAPHIC SCALE:

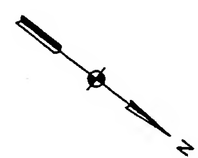
0 10' 20'

(SCALE IN FEET)

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH MAIN DAM CORE TRENCH GROUTING STA. 25+30 TO STA. 27+60			
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA			
SUBMITTED: for CARL E. COLE RESIDENT GEOLOGIST		APPROVED: PAUL M. PARSONEAULT RESIDENT ENGINEER	
DR. BY: ERE	TR. BY:	GEOL. BY: BAB	FILE No: PLATE 89


MATCH LINE STA. 27+60
B
C
A
28+00





LEGEND:

DIRECTION OF GROUT TRAVEL. POINT OF ARROW INDICATES LOCATION AT WHICH LEAK OR COMMUNICATION OCCURRED. ACTUAL PATH IS NOT KNOWN.

GRAPHIC SCALE:

0 10'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM

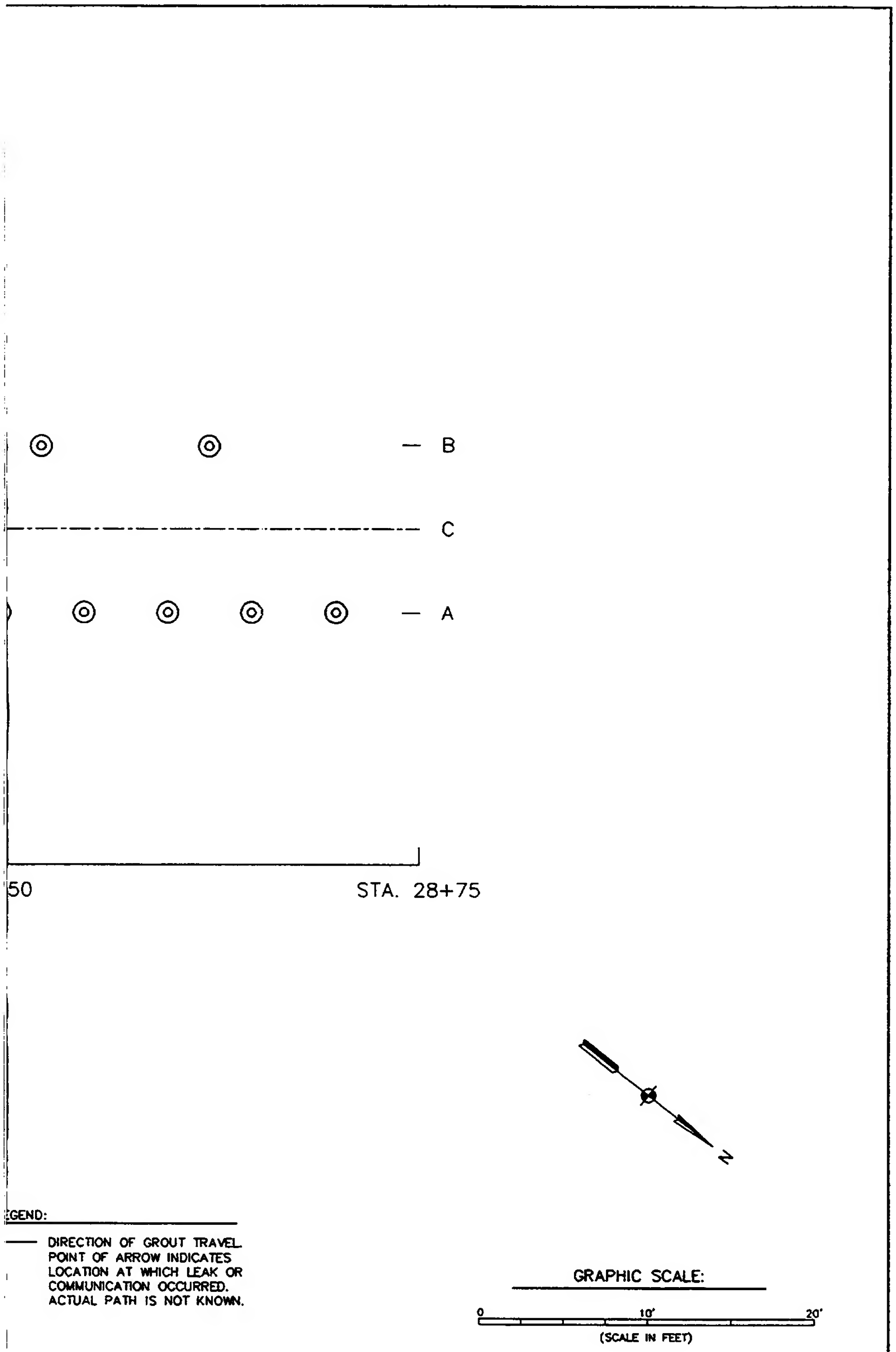
CORE TRENCH GROUTING
STA. 27+60 TO STA. 28+75

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: PAUL M. PAR

DR. BY:	TR. BY:	CKD. BY:	FILE No.:
ERE		BAB	PLATE



LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

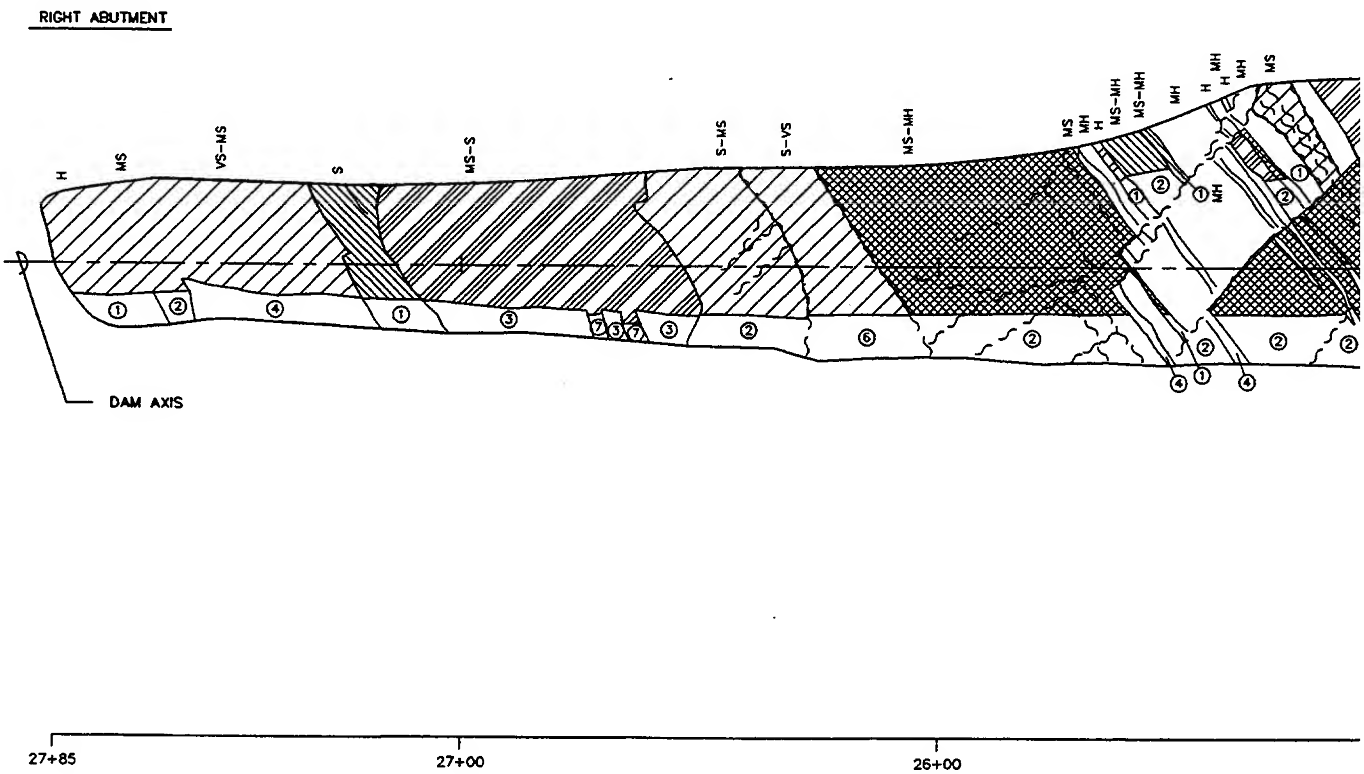
MAIN DAM

CORE TRENCH GROUTING
STA. 27+60 TO STA. 28+75

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE No.:
ERE		BAB	PLATE 90



GEOLOGIC MAP LEGEND AND SYMBOLS

KELVIN AND FRONTIER FORMATIONS (BEDROCK)

1 — SANDSTONE: Gray and brownish-gray; hard to very hard where unweathered; generally fine grained; slightly to highly fractured; solutioning evident along many fractures; fractures exhibit widths of one inch or greater in some cases; strikes of most open fractures are generally nearly perpendicular to bedding; calcareous-siliceous matrix; high permeabilities (300+ feet per day (Ft/d)) possible in moderately fractured zones where calcareous matrix has been dissolved along fractures. Numerous springs observed exiting thin beds of hard sandstone along downstream left abutment.

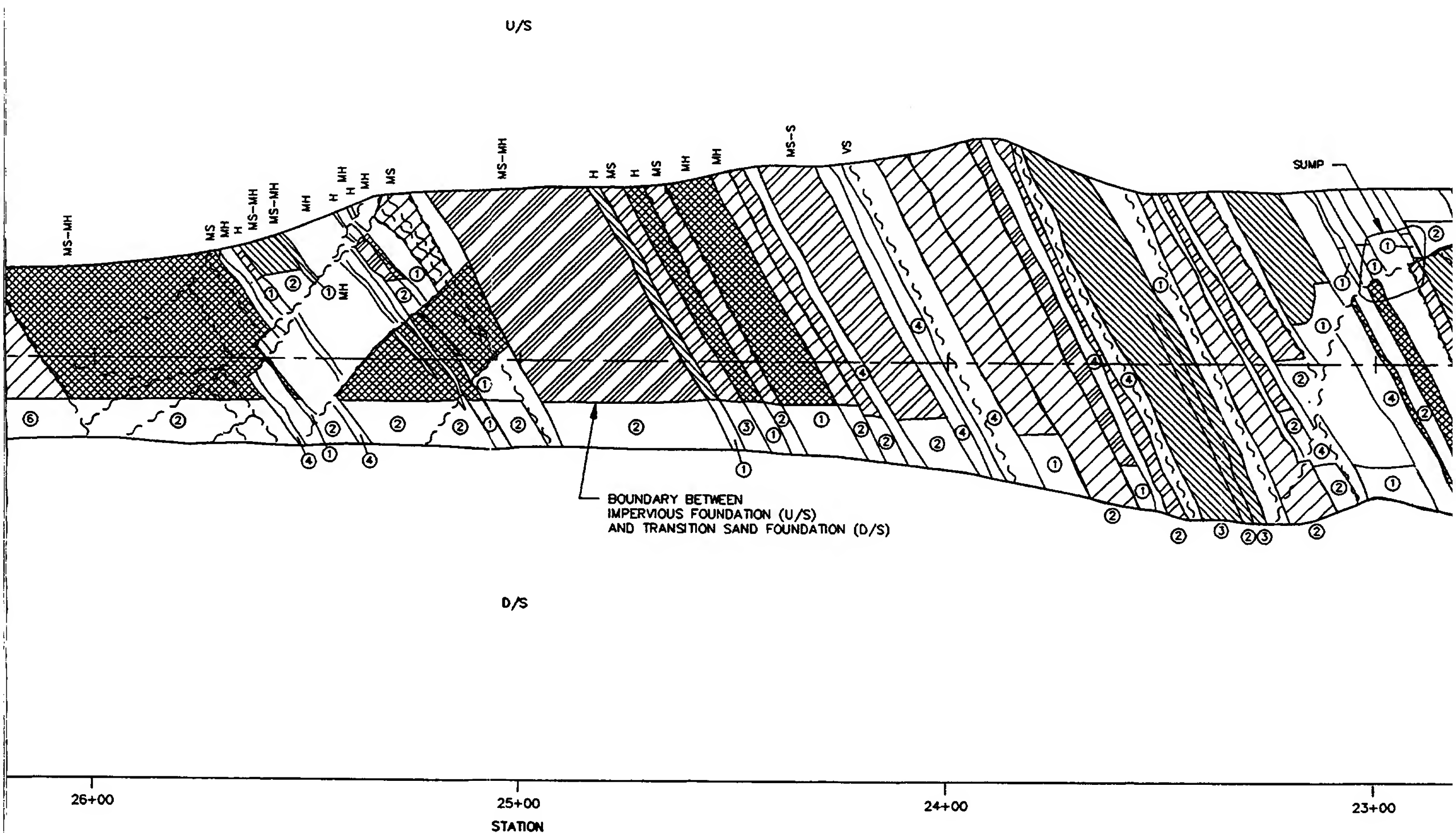
2 — SILTY SANDSTONE/SANDY SILTSTONE: Predominantly reddish-brown and reddish-brown with gray mottling; moderately soft to moderately hard where unweathered; intensely to slightly fractured; fracture widths generally smaller than in the gray sandstone; moderate permeabilities possible through fractures generally not along bedding; air slakes readily in some cases; calcareous; some thin beds and zones of gray sandstone as described above are included in these units.

3 — SILTSTONE: Predominantly brown and reddish-brown with gray mottling, some gray beds; generally moderatly soft to soft; intensely to slightly fractured, fractures generally tight with some small openings; fracture orientations highly variable; low permeabilities; usually air slakes readily, calcareous.

4 — CLAYSTONE: Predominantly reddish-brown and gray mottled, s beds; generally soft to very soft; often intensely fractured; fr generally tight and at random orientations; relatively imperviou slakes readily; variably calcareous.

6 — SOAPSTONE: Gray to gray-green; variably altered; very soft intensely sheared; tight fractures.

7 — CONGLOMERATE: Multicolored course material in gray matrix; h hard matrix with very hard quartzitic course material where ur generally slightly fractured at surface but highly fractured in c depth; large fractures often exceed 1 inch in width, open frac generally not along bedding; calcareous matrix.



ND SYMBOLS

CLAYSTONE: Predominantly reddish-brown and gray mottled, some gray beds; generally soft to very soft; often intensely fractured; fractures generally tight and at random orientations; relatively impervious; air slakes readily; variably calcareous.

SOAPSTONE: Gray to gray-green; variably altered; very soft intensely sheared; tight fractures.

CONGLOMERATE: Multicolored course material in gray matrix; hard to very hard matrix with very hard quartzitic course material where unweathered; generally slightly fractured at surface but highly fractured in cores from depth; large fractures often exceed 1 inch in width, open fractures generally not along bedding; calcareous matrix.

LEGEND:

Linear Ft. of Fracture /Sq. Yd. of area (Average)

- 0 – .5 ft/yd^2
- .5 – 1.0 ft/yd^2
- 1.0 – 1.5 ft/yd^2
- 1.6 – 2.0 ft/yd^2
- > 2.0 ft/yd^2
- Dental concrete
- Shear or Fault
- Fault

VS = Very fine
S = Soft
MS = Moderately soft
MH = Moderately hard
H = Hard
VH = Very hard

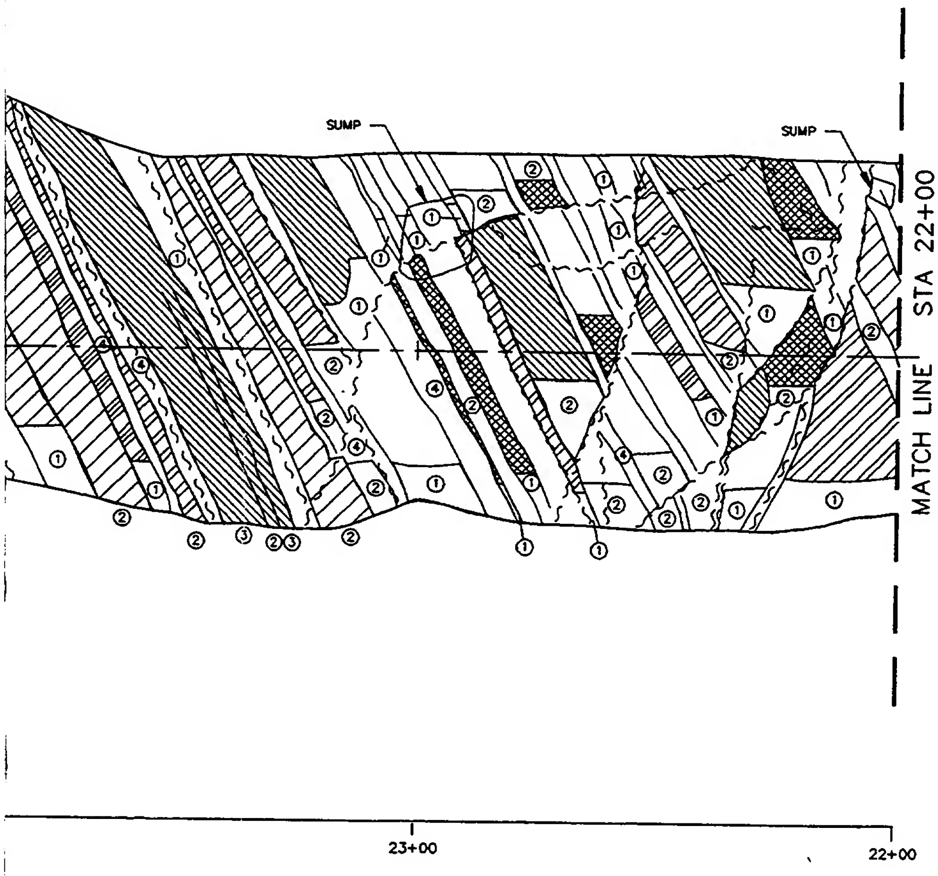
NOTE:

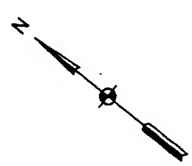
Rock types shown in the transition sand foundation applies generally upstream in the Impervious zone as well.

0

SUBMITTED:

ERE





NOTE:

Rock types shown in the transition sand foundation applies generally upstream in the Impervion zone as well.

GRAPHIC SCALE:

0 20 40 60 80 100

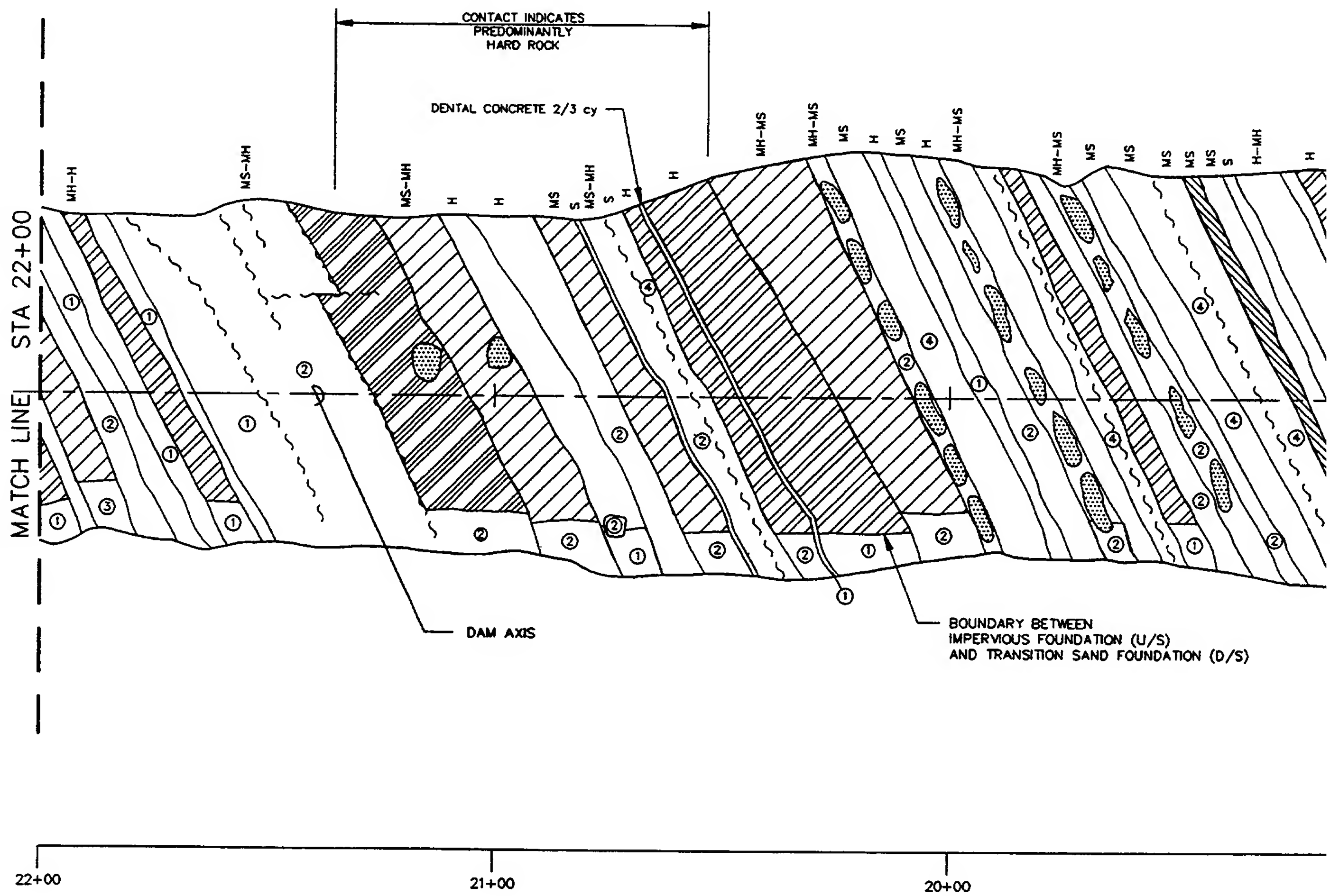
(SCALE IN FEET)

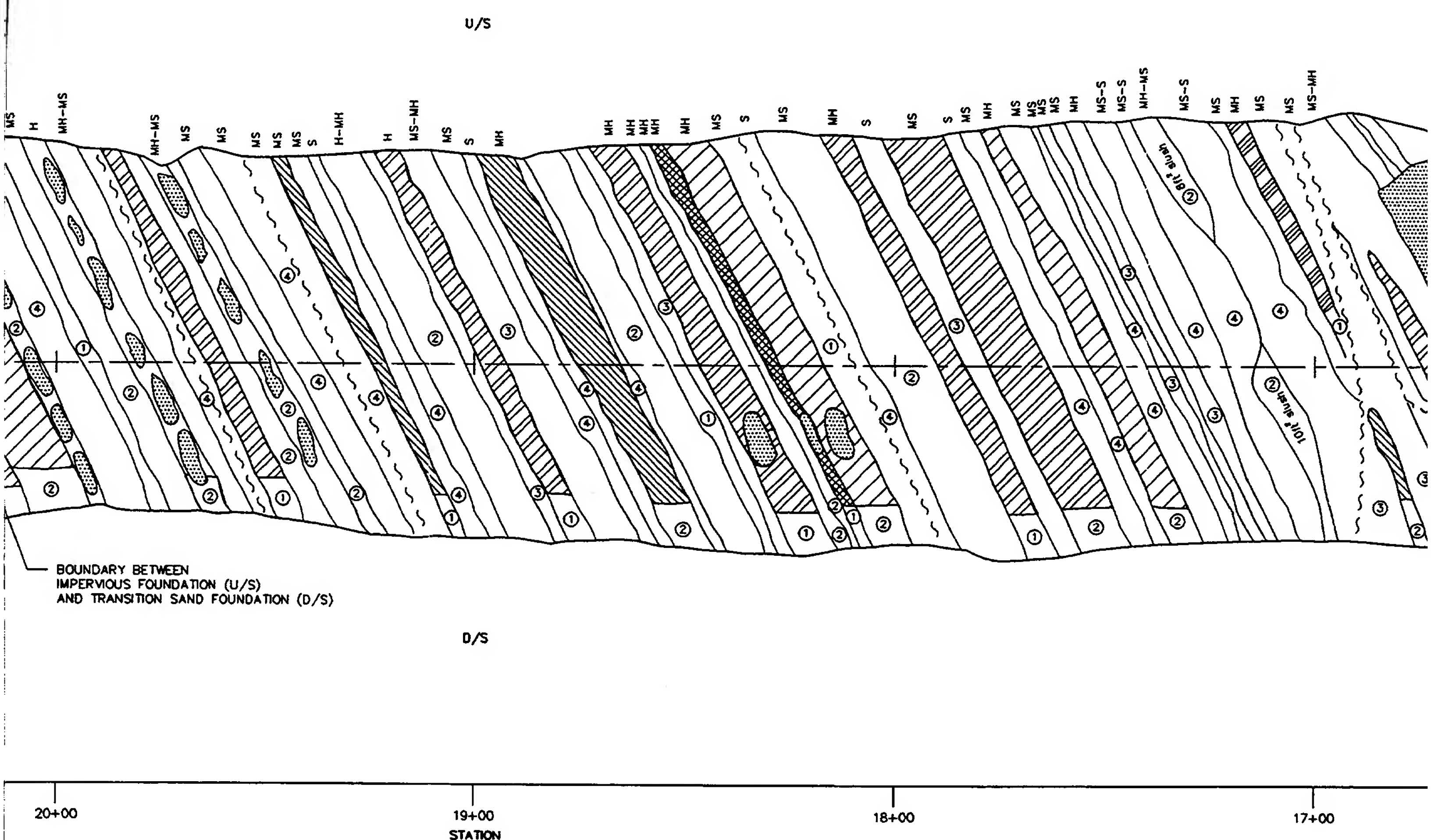
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
MAIN DAM
CORE TRENCH FOUNDATION
TREATMENT MAP
STA. 27+85 TO STA. 22+00

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:		APPROVED:
Robert L. Trest for CARL E. COLE, RESIDENT GEOLOGIST		PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE No:
ERE		CEC	PLATE 91


CONTACT INDICATES
PREDOMINANTLY
HARD ROCK
DENTAL CONCRETE 2/3 cy
MATCH LINE STA 22+00
MH-H
MS-MH
MS-MH
H
H
MS
S
MS-MH
S
H
H
MH-MS
MH-MS
MS
H
MS
H
MH-MS
MH-MS
MS
MS
MS
MS
MS
S
H-MH
H
DAM AXIS
BOUNDARY BETWEEN
IMPERVIOUS FOUNDATION (U/S)
AND TRANSITION SAND FOUNDATION (D/S)
22+00
21+00
20+00



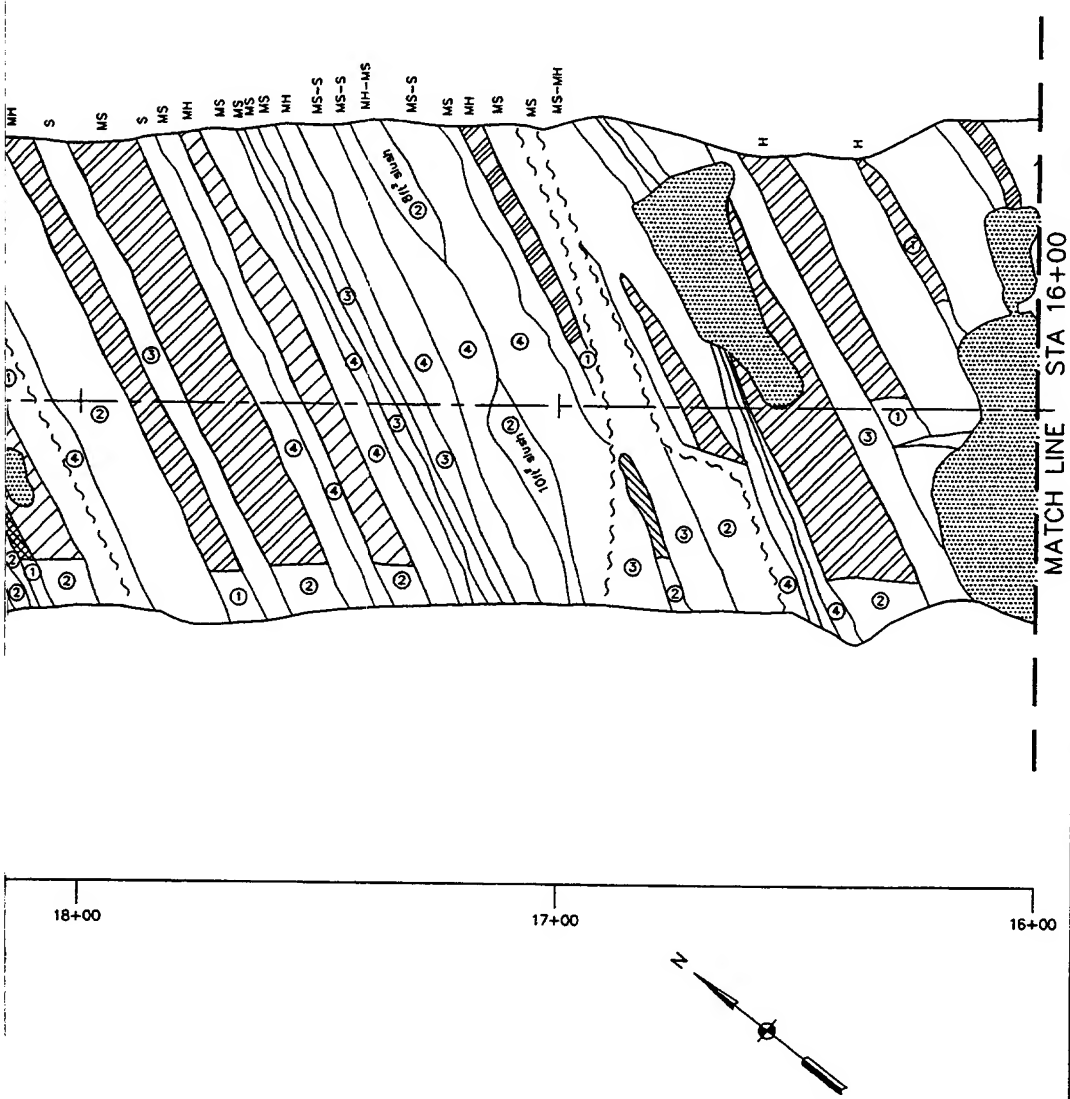
NOTE:
SEE LEGEND AND NOTE ON PLATE 91.

0 20

SUBMITTED:

for CARL E.

ERE



GRAPHIC SCALE:

NOTE ON PLATE 91.

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
MAIN DAM
CORE TRENCH FOUNDATION
TREATMENT MAP
STA. 22+00 TO STA. 16+00

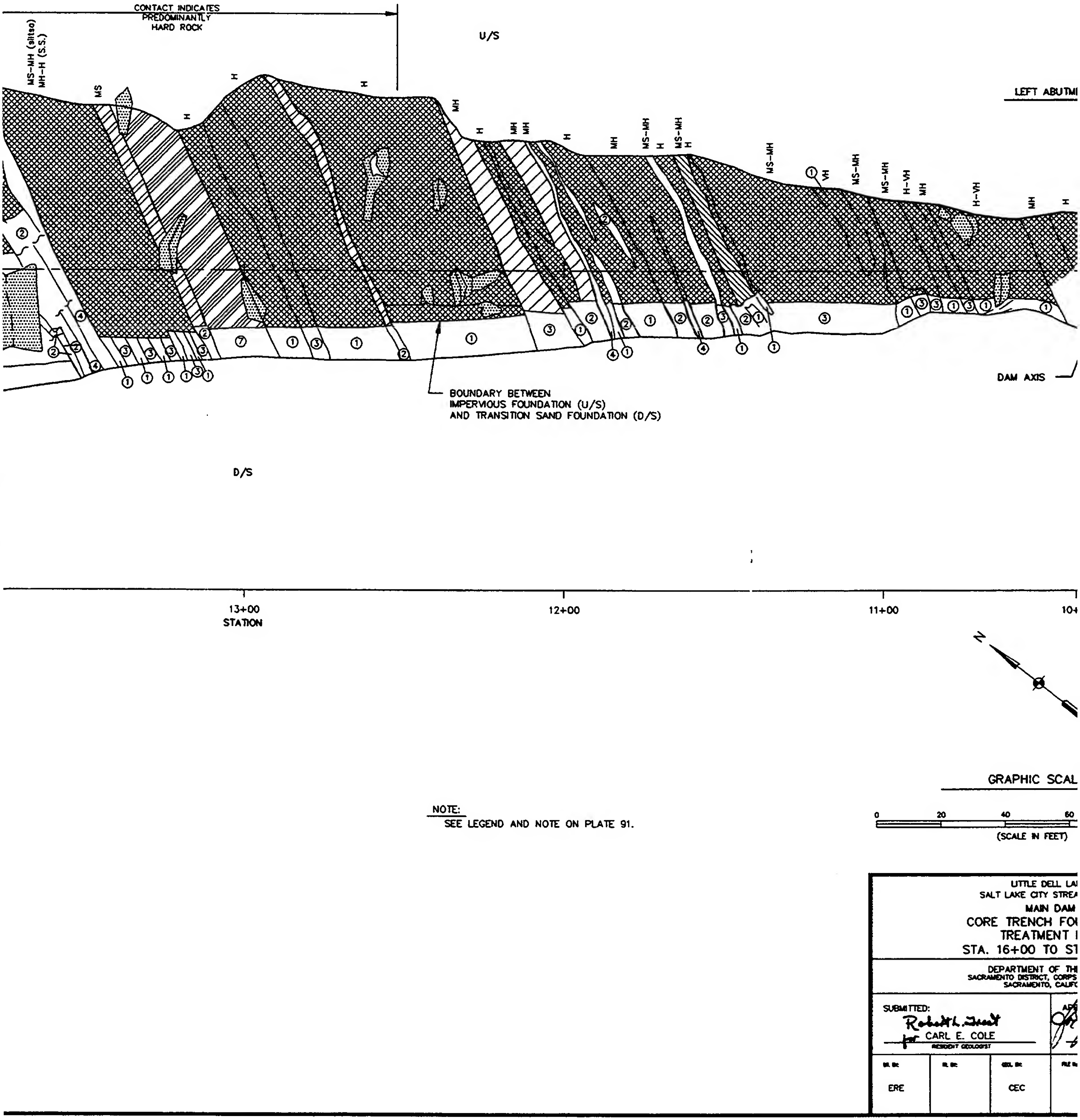
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Treat for CARL E. COLE, RESIDENT GEOLOGIST

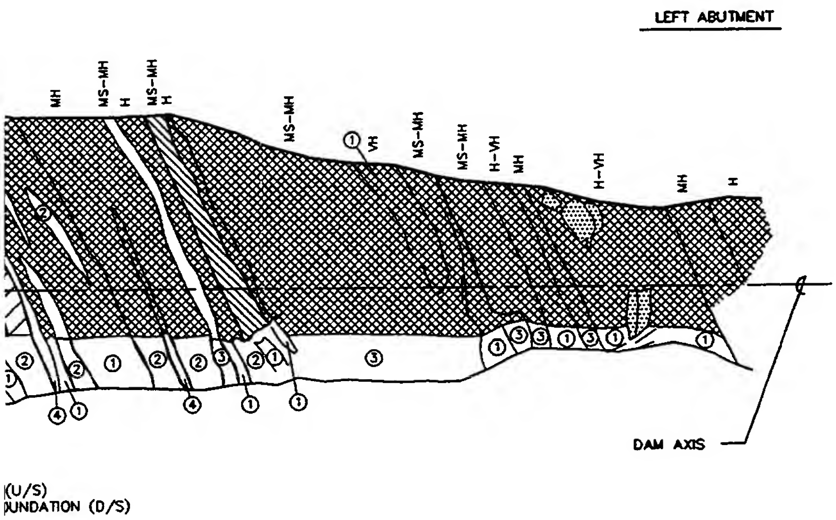
APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

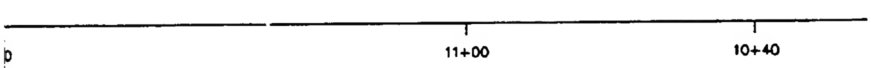
DR. BY:	TR. BY:	GEOL. BY:	FILE NO.:
ERE		CEC	PLATE 92

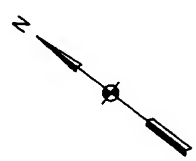
CONTACT INDICATES PREDOMINANTLY HARD ROCK
MH
MH
MH-H
MH
MS
MS
MS-MH
MS-MH
MS-S
MH-MS
MS-MS
S
H
CONTACT IN PREDOMIN HARD R
MS-MH (siltst)
MH-H (S.S.)
MS
MATCH LINE
STA 16+00
16+00
15+00
14+00



NOTE:
SEE LEGEND AND NOTE ON PLATE 91.







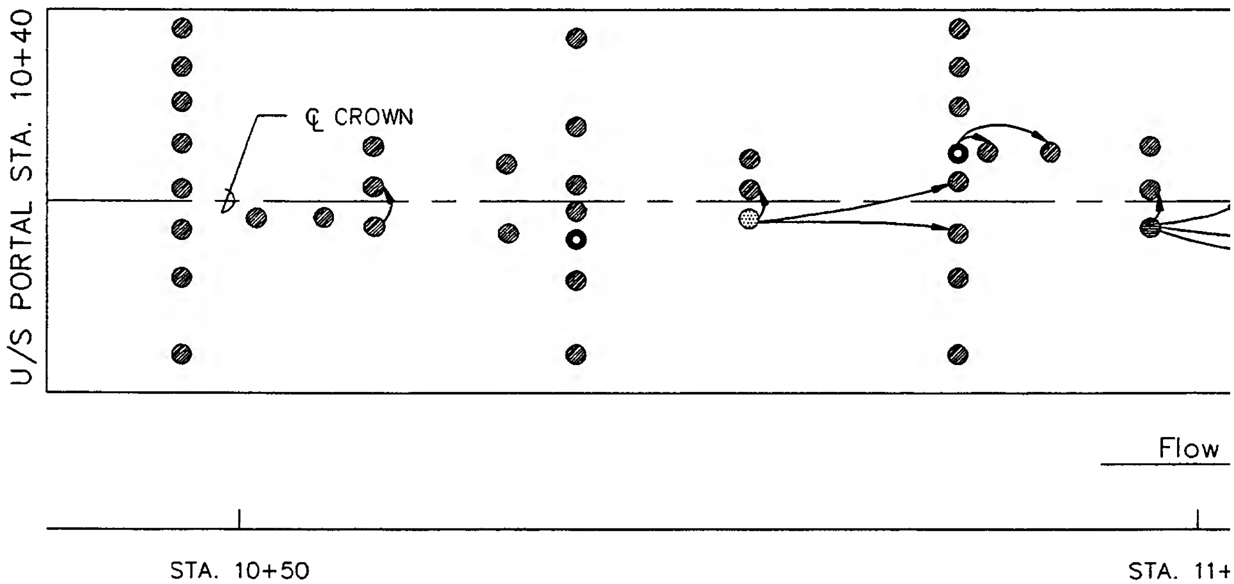
GRAPHIC SCALE:

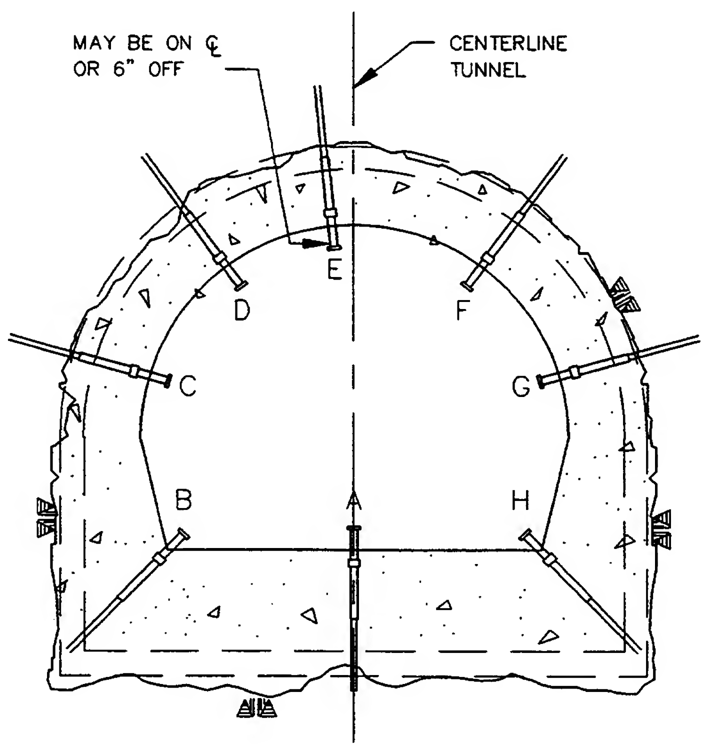
N PLATE 91.

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH
MAIN DAM
CORE TRENCH FOUNDATION
TREATMENT MAP
STA. 16+00 TO STA. 10+40

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

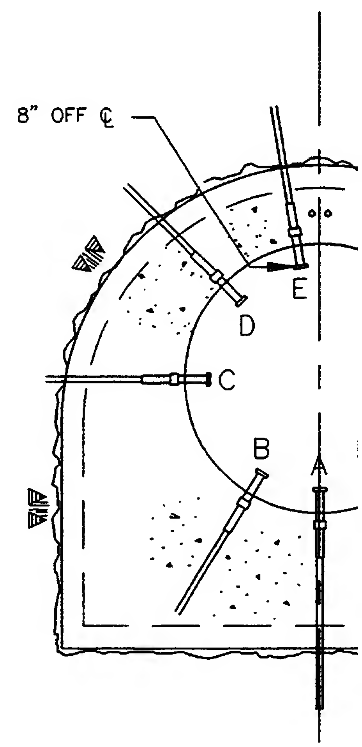
SUBMITTED:		APPROVED:	
for CARL E. COLE, RESIDENT GEOLOGIST		PAUL M. PARSONEAULT, RESIDENT ENGINEER	
ERE		CEC	PLATE 93





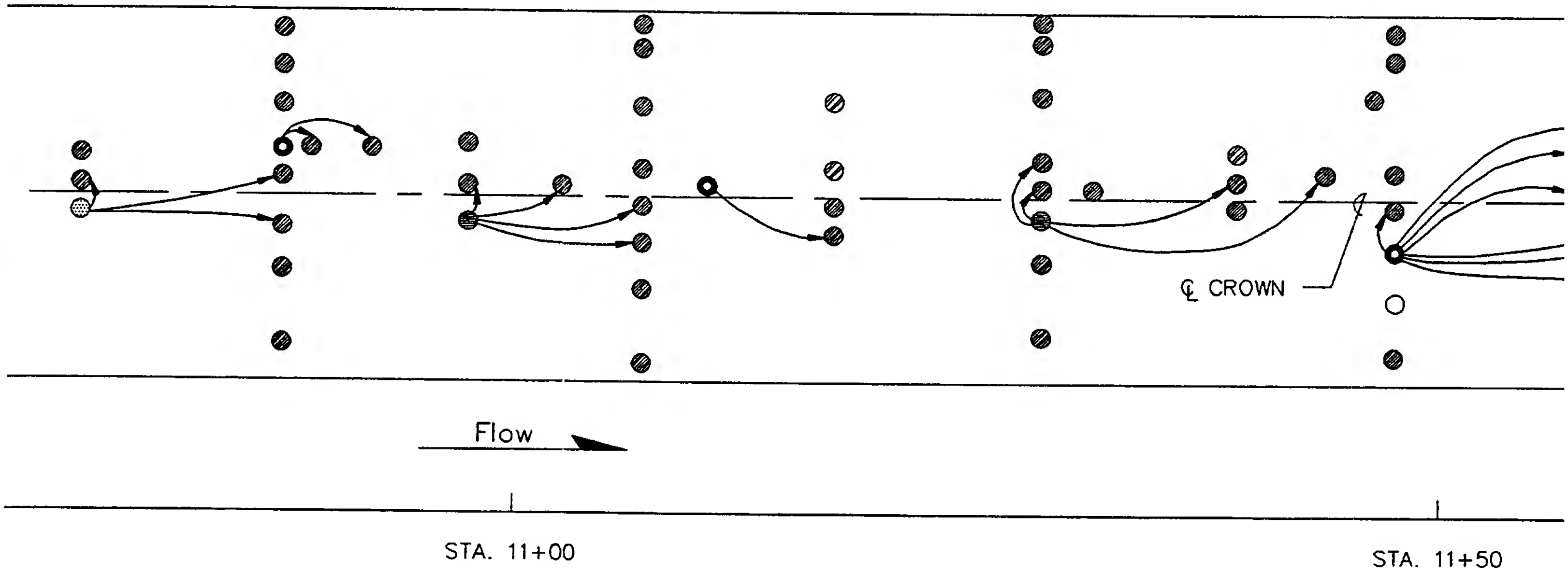
UPSTREAM TUNNEL
(UPSTREAM PORTAL TO E.C.C.)

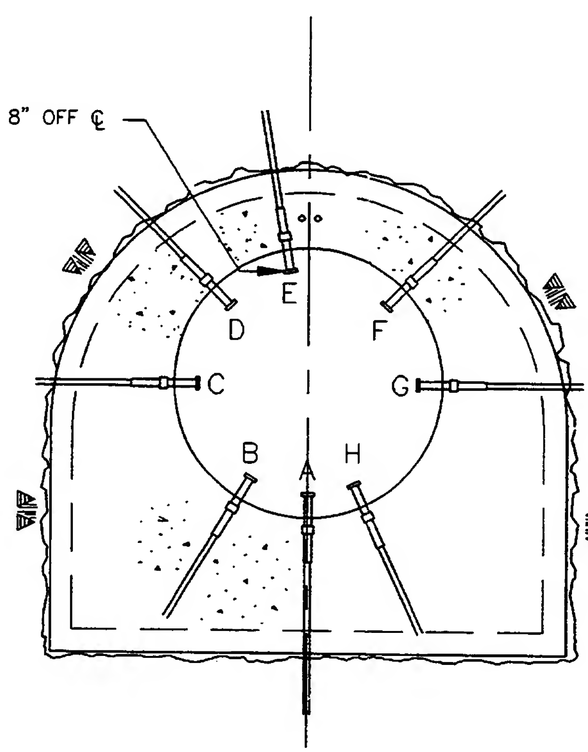
VIEW LOOKING DOWNSTREAM



DOWNSTREAM
(E.C.C. TO STA.

VIEW LOOKING DOW





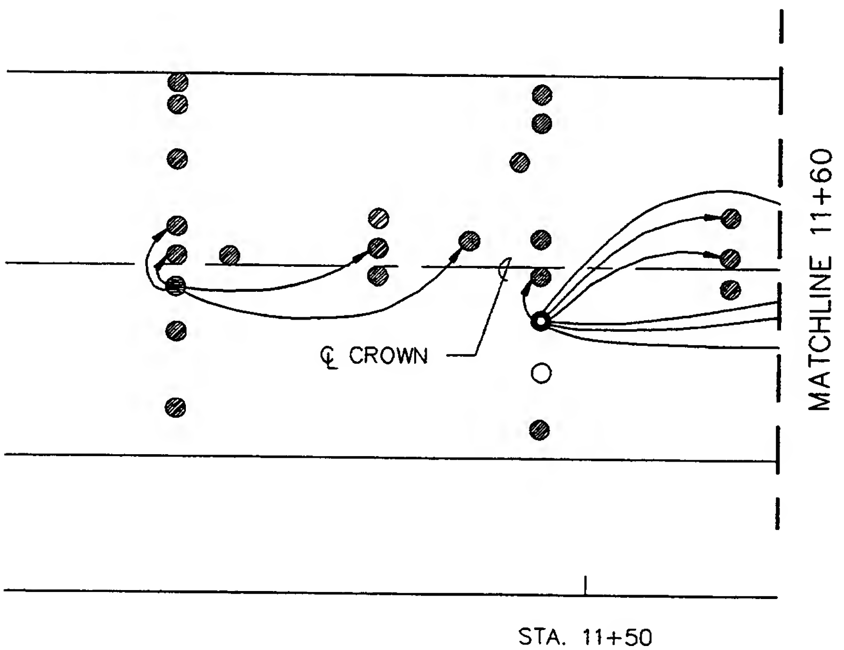
DOWNSTREAM TUNNEL
(E.C.C. TO STA. 19+50)

VIEW LOOKING DOWNSTREAM

LEGEND:

GROUT PLACED (BAGS)

- 0 – 2
- 2 – 10
- 10 – 50
- 50 – 100
- 100+
- NOT CONNECTED
- DIRECTION OF GROUNT TRAVEL
- FRACTURE



LEGEND:

GROUT PLACED (BAGS)

- 0 – 2
- 2 – 10
- 10 – 50
- 50 – 100
- 100+
- NOT CONNECTED
- DIRECTION OF GROUNT TRAVEL
- FRACTURE

GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS

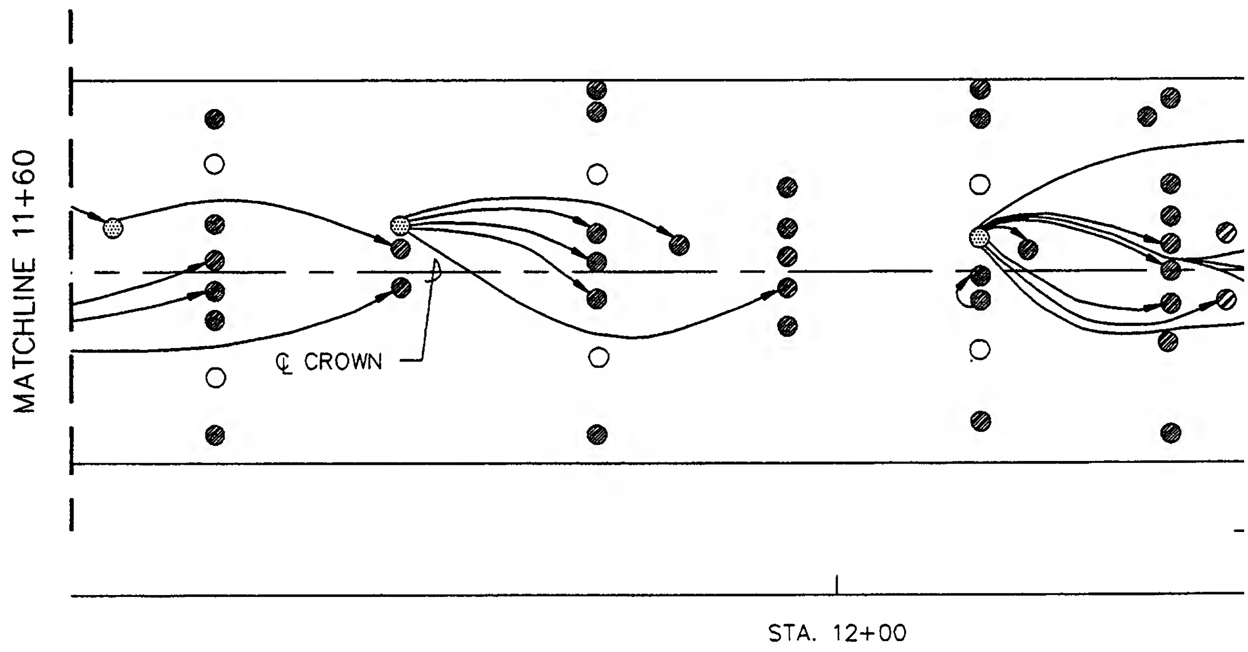
TUNNEL – CONTACT GROUTING
STA. 10+40 TO STA. 11+60

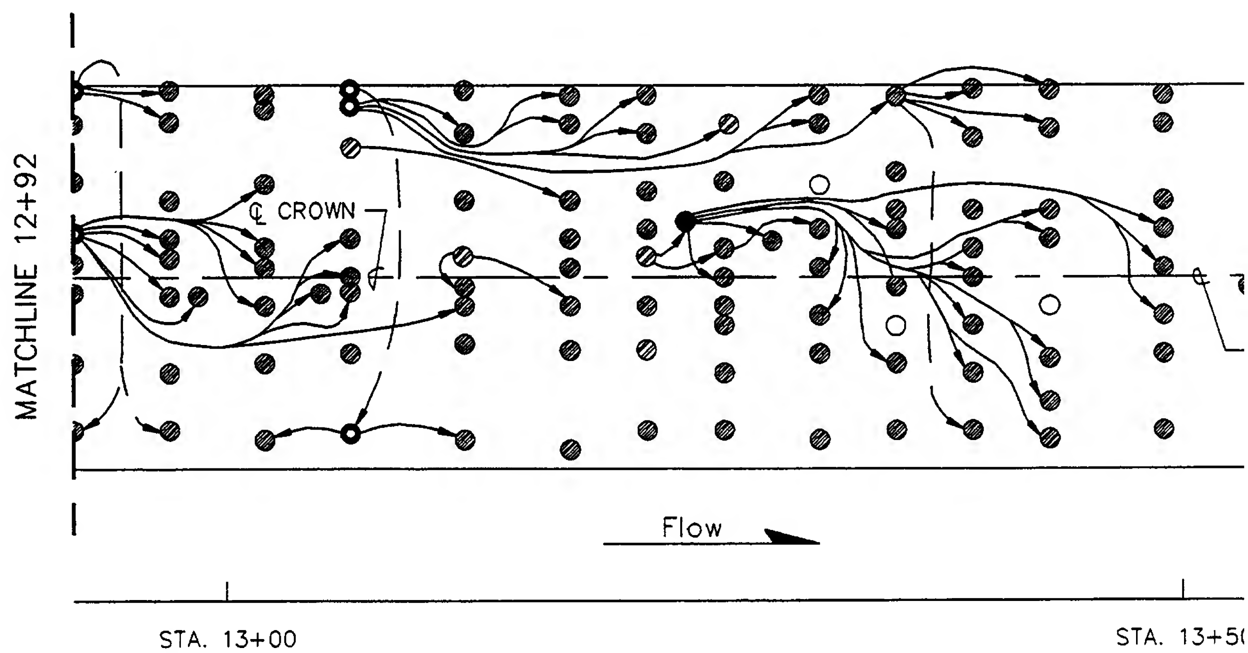
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

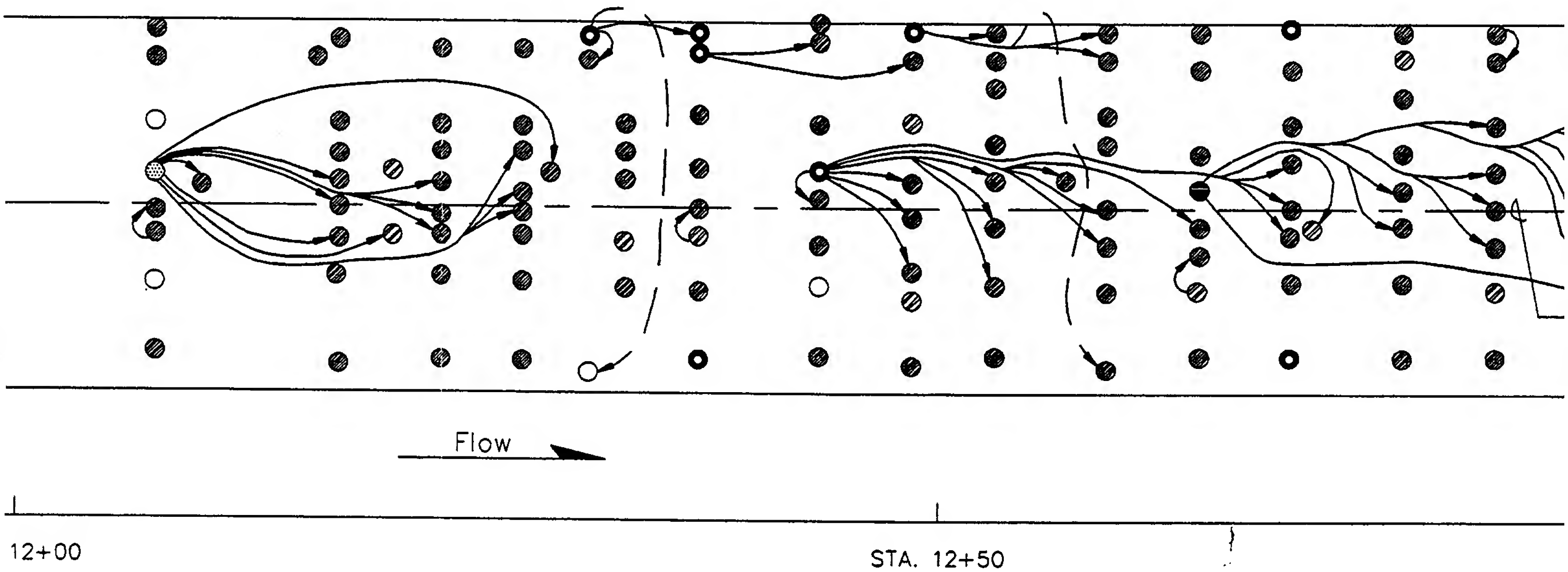
SUBMITTED: Robert L. [illegible] for CARL E. COLE, RESIDENT GEOLOGIST

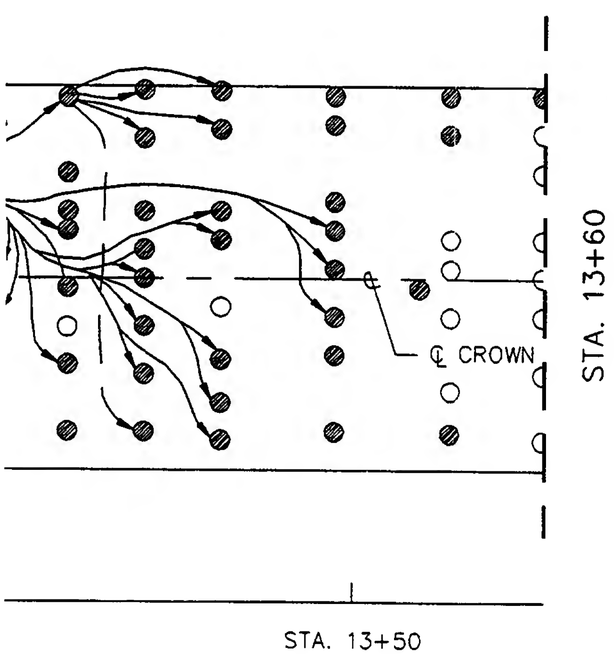
APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE | | BAB | PLATE 94


MATCHLINE 11+60
℄ CROWN
STA. 12+00


MATCHLINE 12+92
℄ CROWN
Flow
STA. 13+00
STA. 13+5





NOTE:
SEE LEGEN

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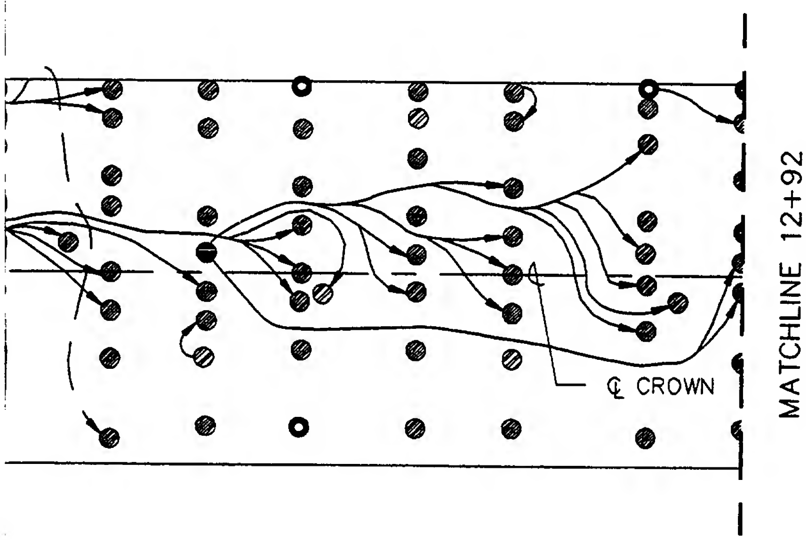
SUBMITTED:
CARL E. COL

ERE



NOTE:
SEE LEGEND ON PLATE 94

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

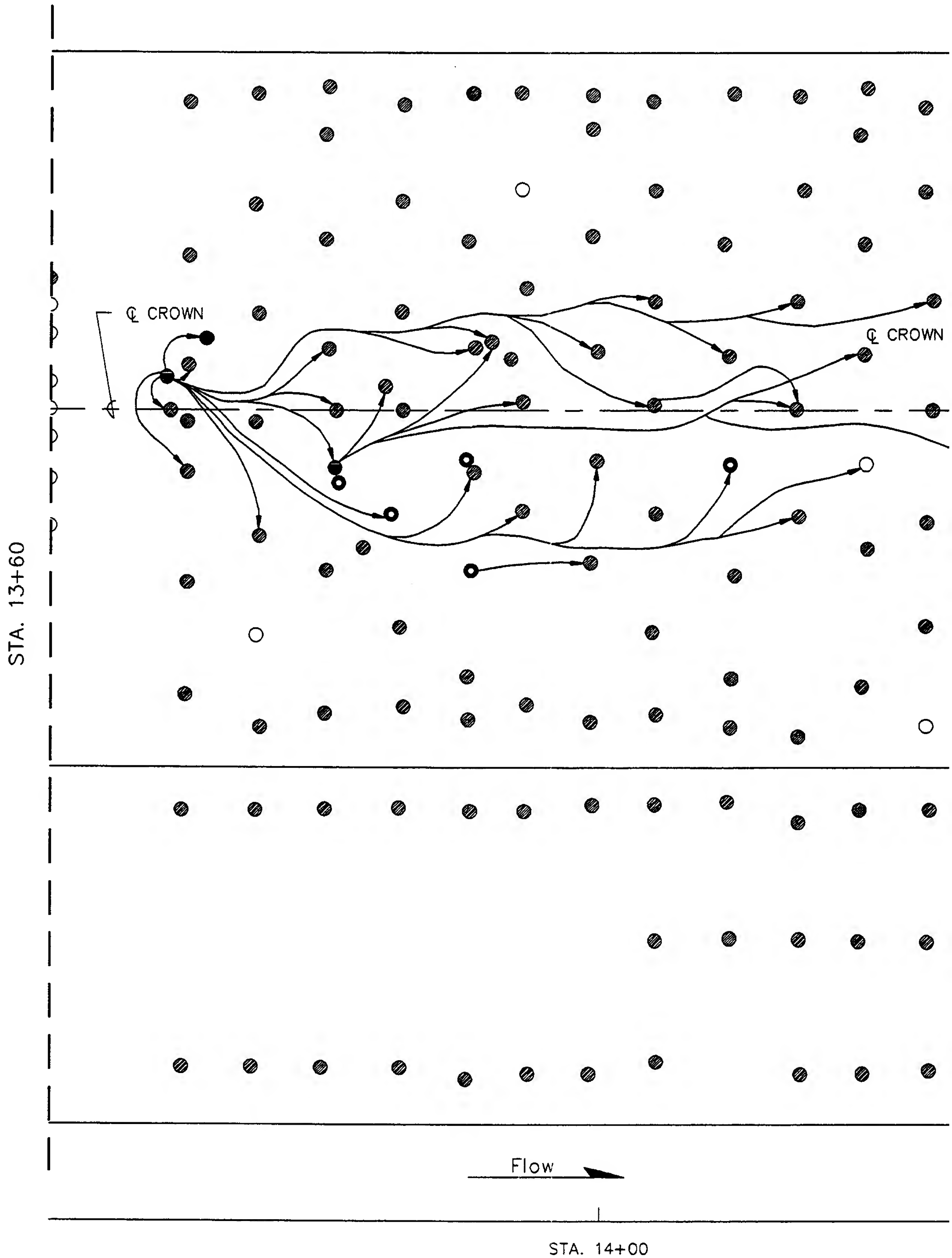
OUTLET WORKS
TUNNEL – CONTACT GROUTING
STA. 11+60 TO STA. 13+60

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

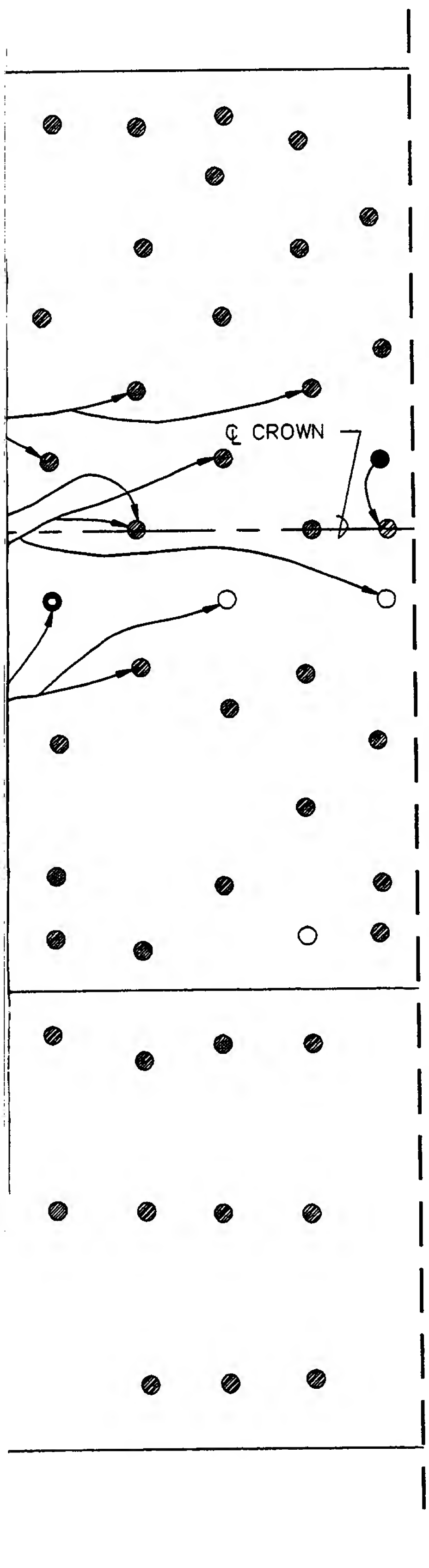
SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY	TR. BY	CKD. BY	FILE No.
ERE		BAB	PLATE 95



℄ CROWN
℄ CROWN
STA. 13+60
Flow
STA. 14+00



NOTE:
SEE LEGEND ON PLATE 94

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

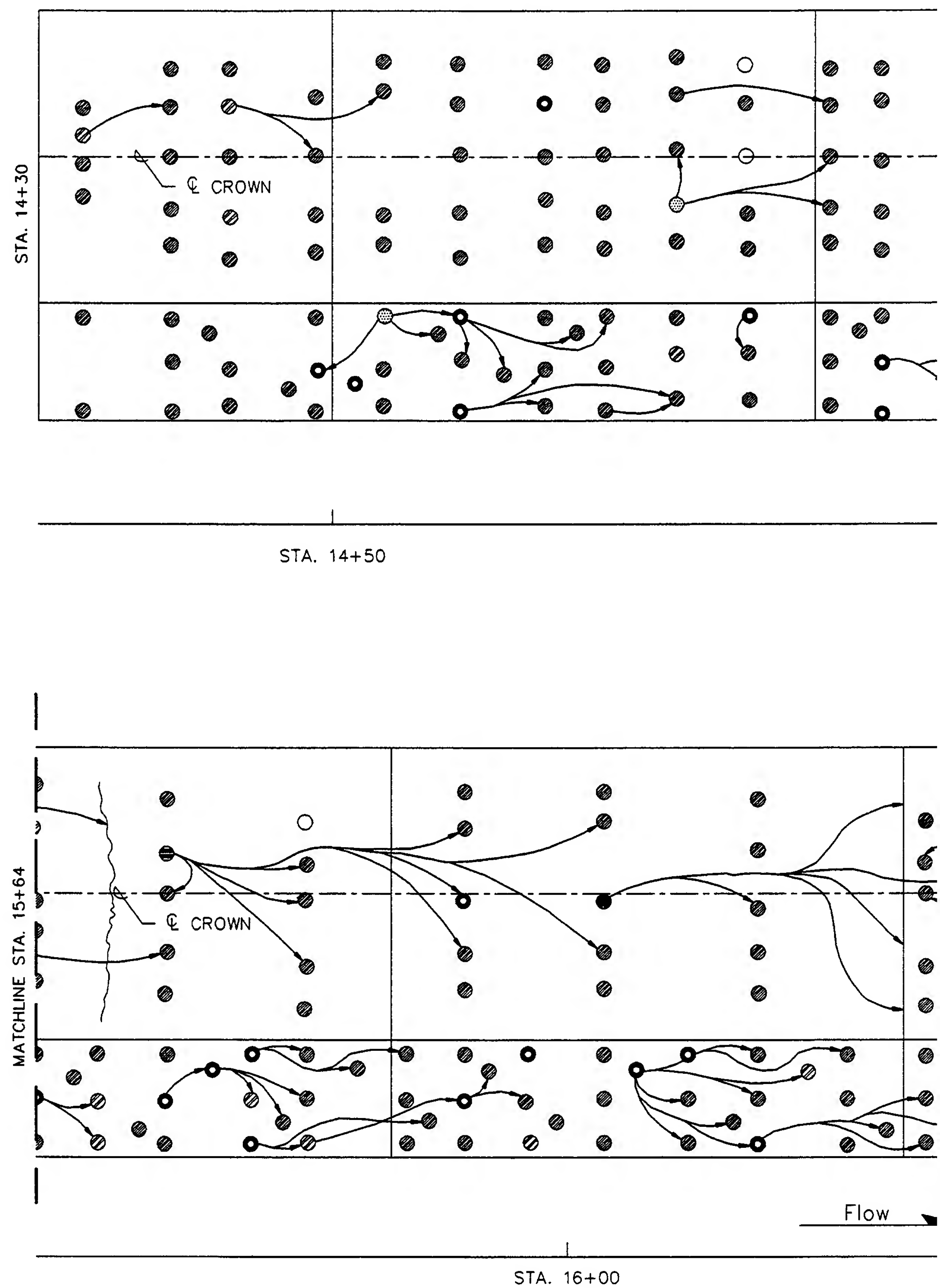
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

OUTLET WORKS
TUNNEL – CONTACT GROUTING
STA. 13+60 TO STA. 14+30

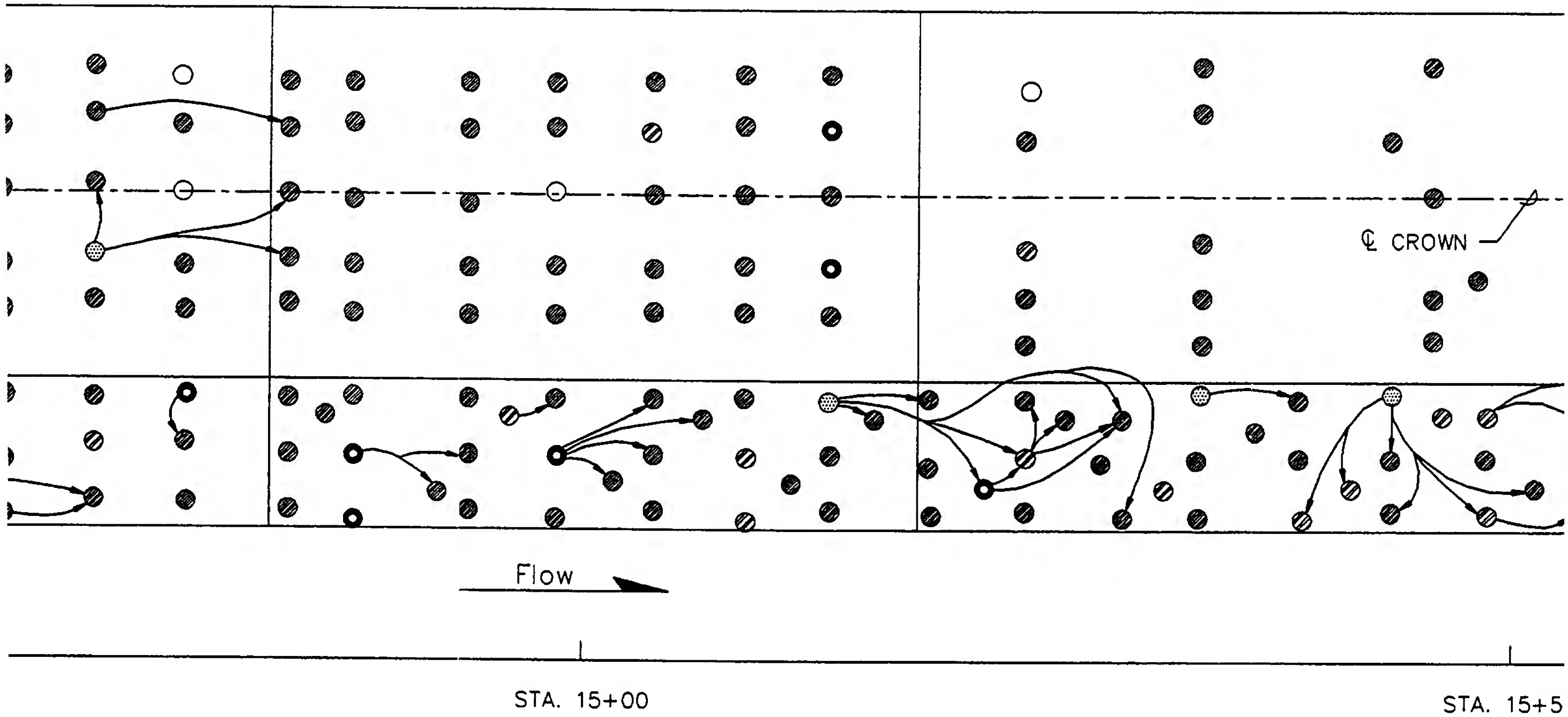
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

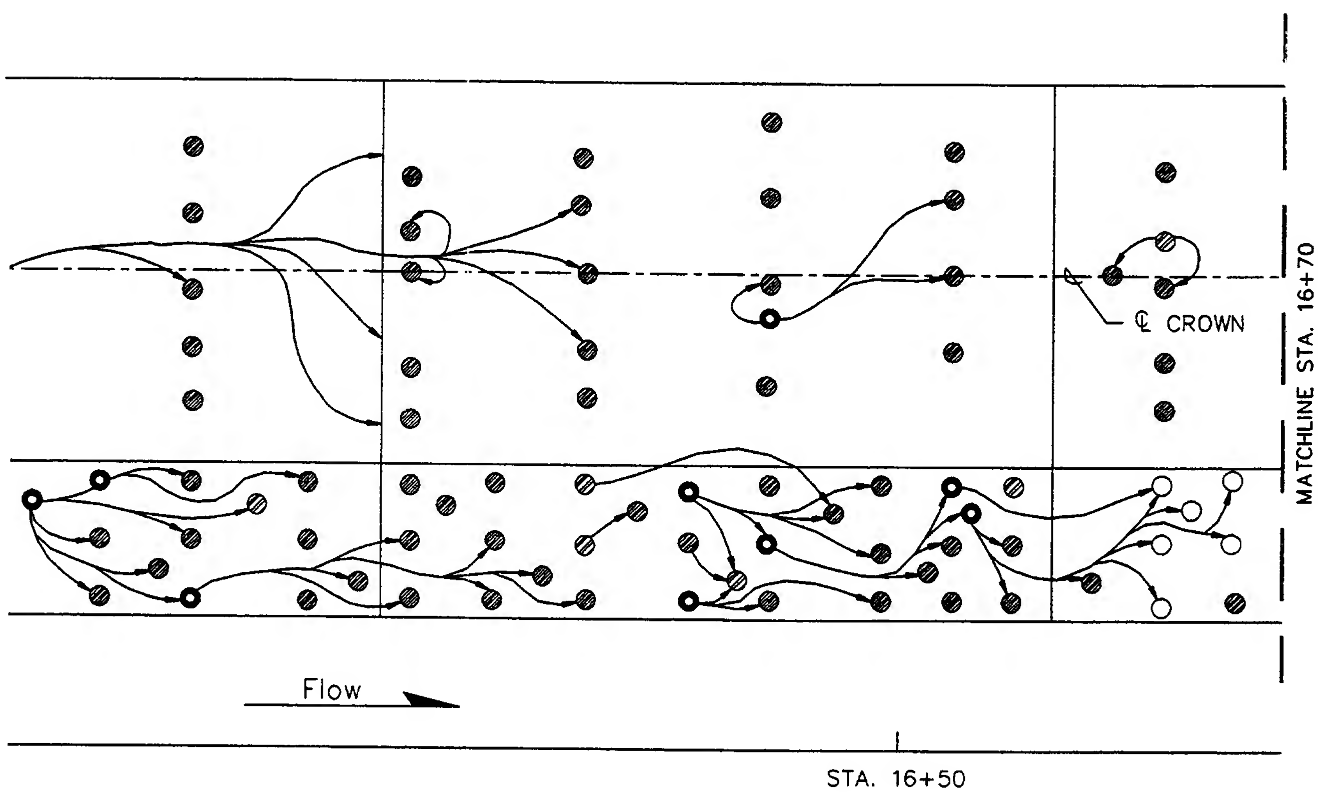
SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE No.:
ERE		BAB	PLATE 96



STA. 14+30
℄ CROWN
STA. 14+50
MATCHLINE STA. 15+64
℄ CROWN
Flow
STA. 16+00





NOTE:
SEE LEGE

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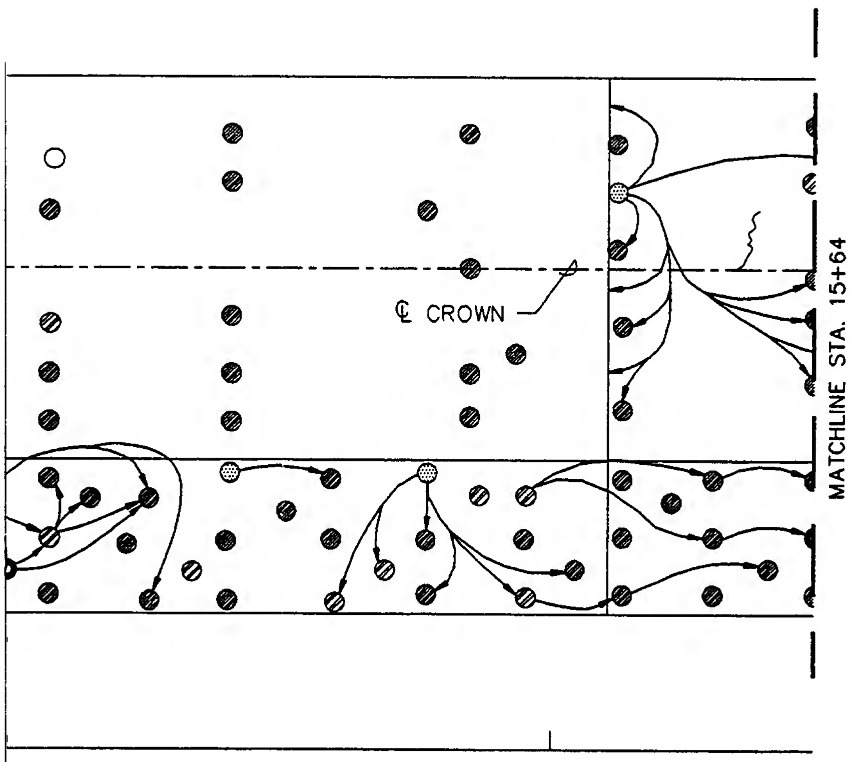
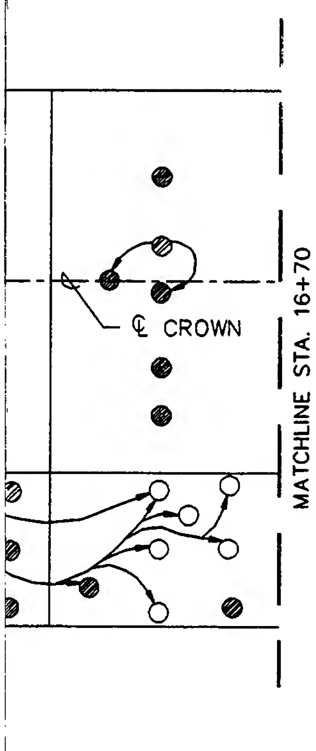
SUBMITTED:
Robert L.
for CARL E. C

ERE

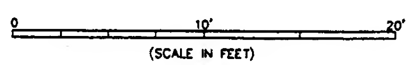


STA. 15+50



NOTE:
SEE LEGEND ON PLATE 94

GRAPHIC SCALE:

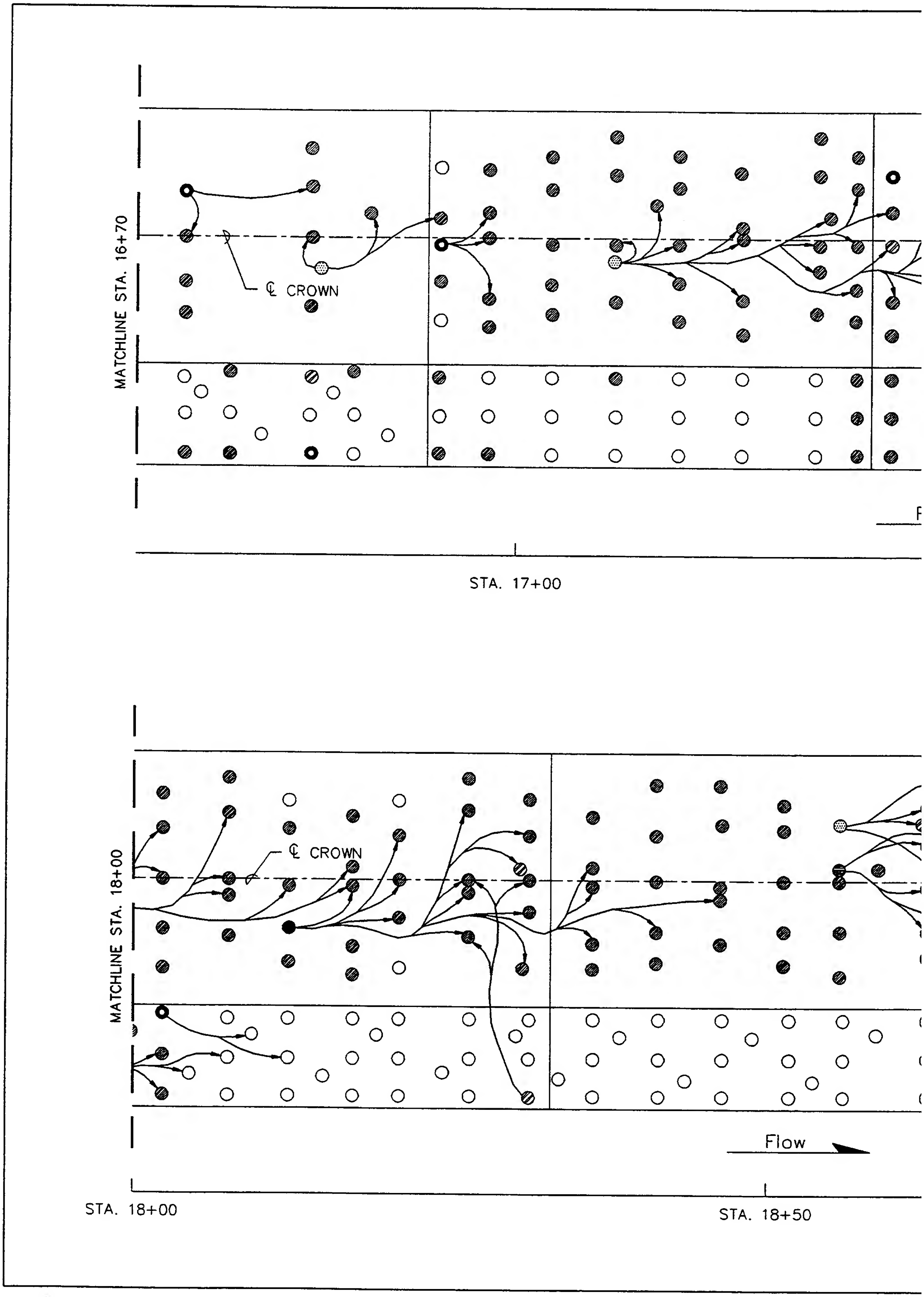


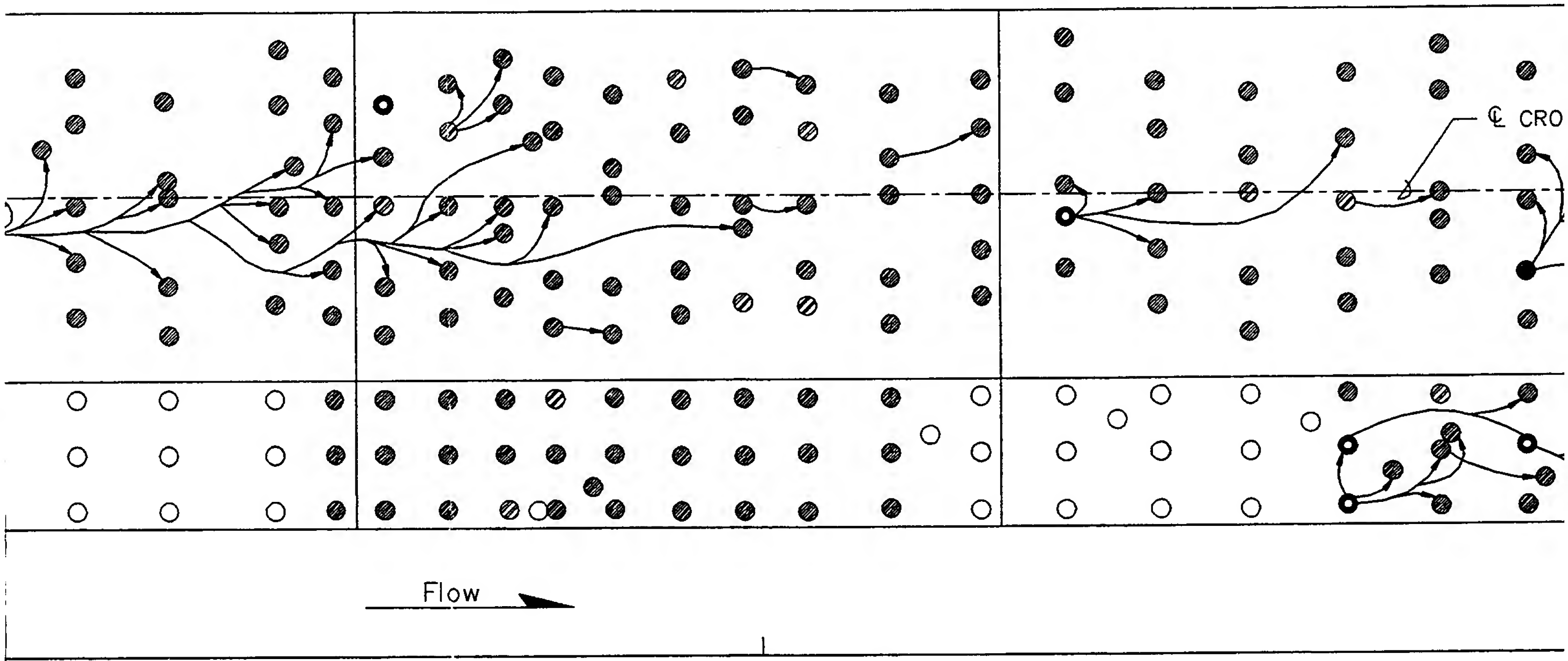
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

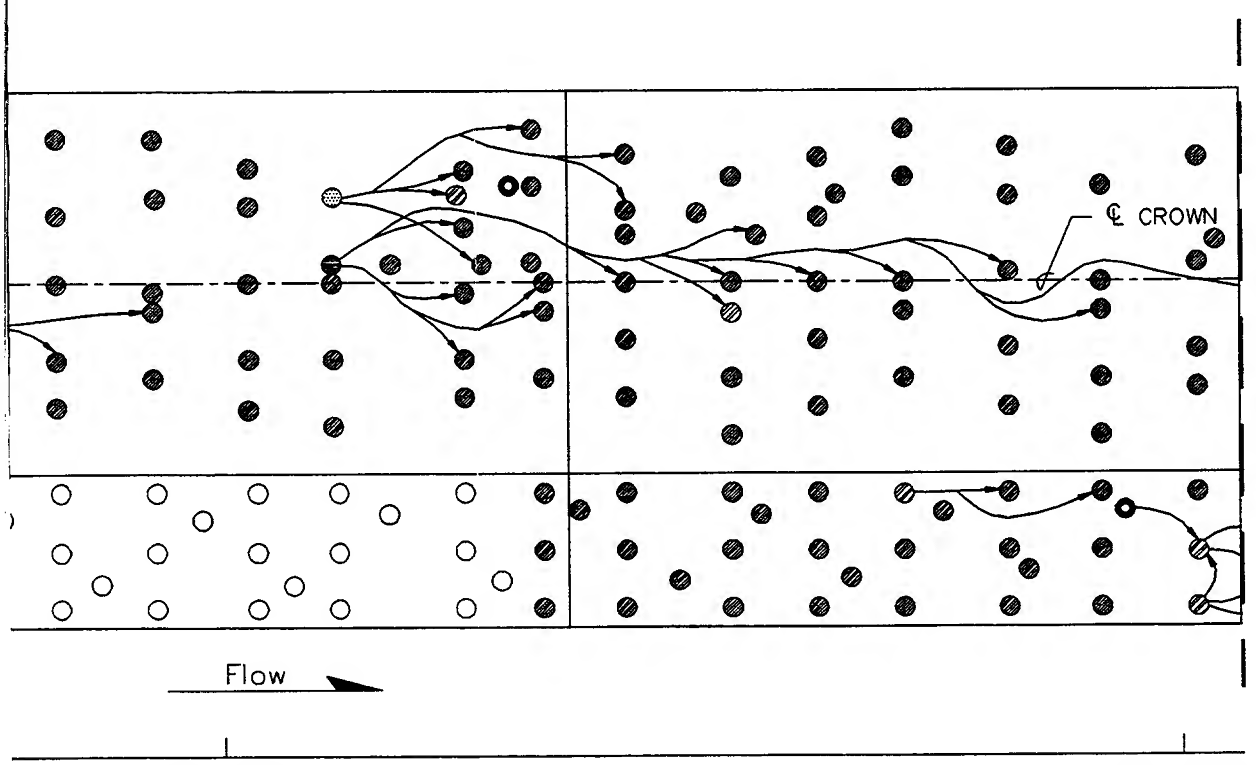
OUTLET WORKS
TUNNEL – CONTACT GROUTING
STA. 14+30 TO STA. 16+70

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	CK. BY:	GEOL. BY: BAB	FILE No.: PLATE 97


MATCHLINE STA. 16+70
℄ CROWN
STA. 17+00
MATCHLINE STA. 18+00
℄ CROWN
Flow
STA. 18+00
STA. 18+50





NOTE:
SEE LEGE

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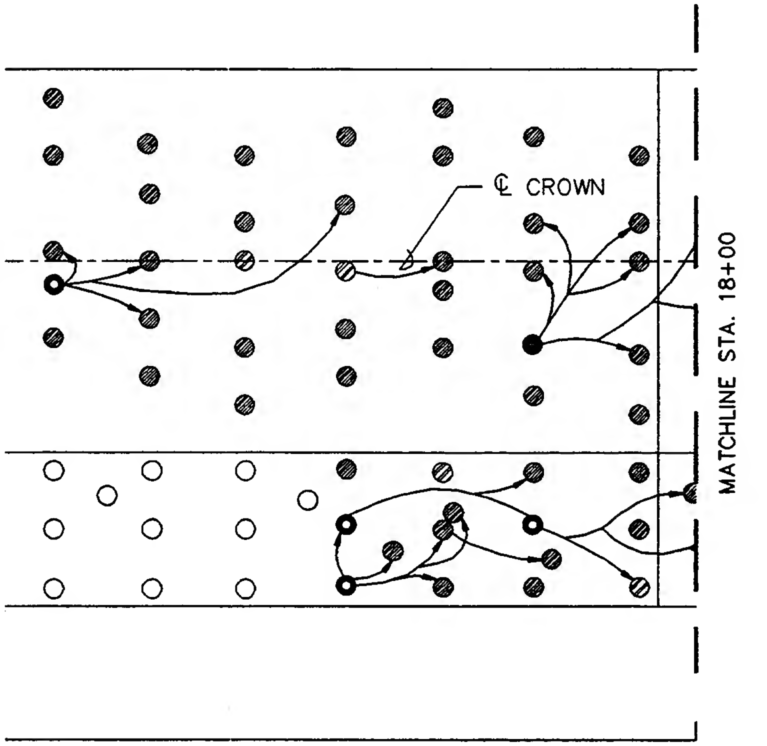
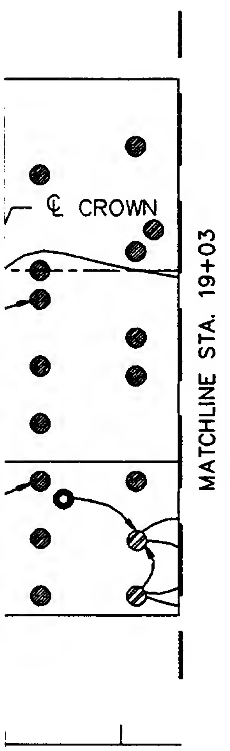
SUBMITTED:
Robert L. ...
for CARL E. C
RESIDENT GEOL

ERE



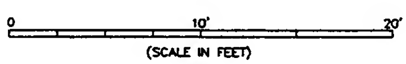
STA. 18+00



STA. 19+00

NOTE:
SEE LEGEND ON PLATE 94

GRAPHIC SCALE:

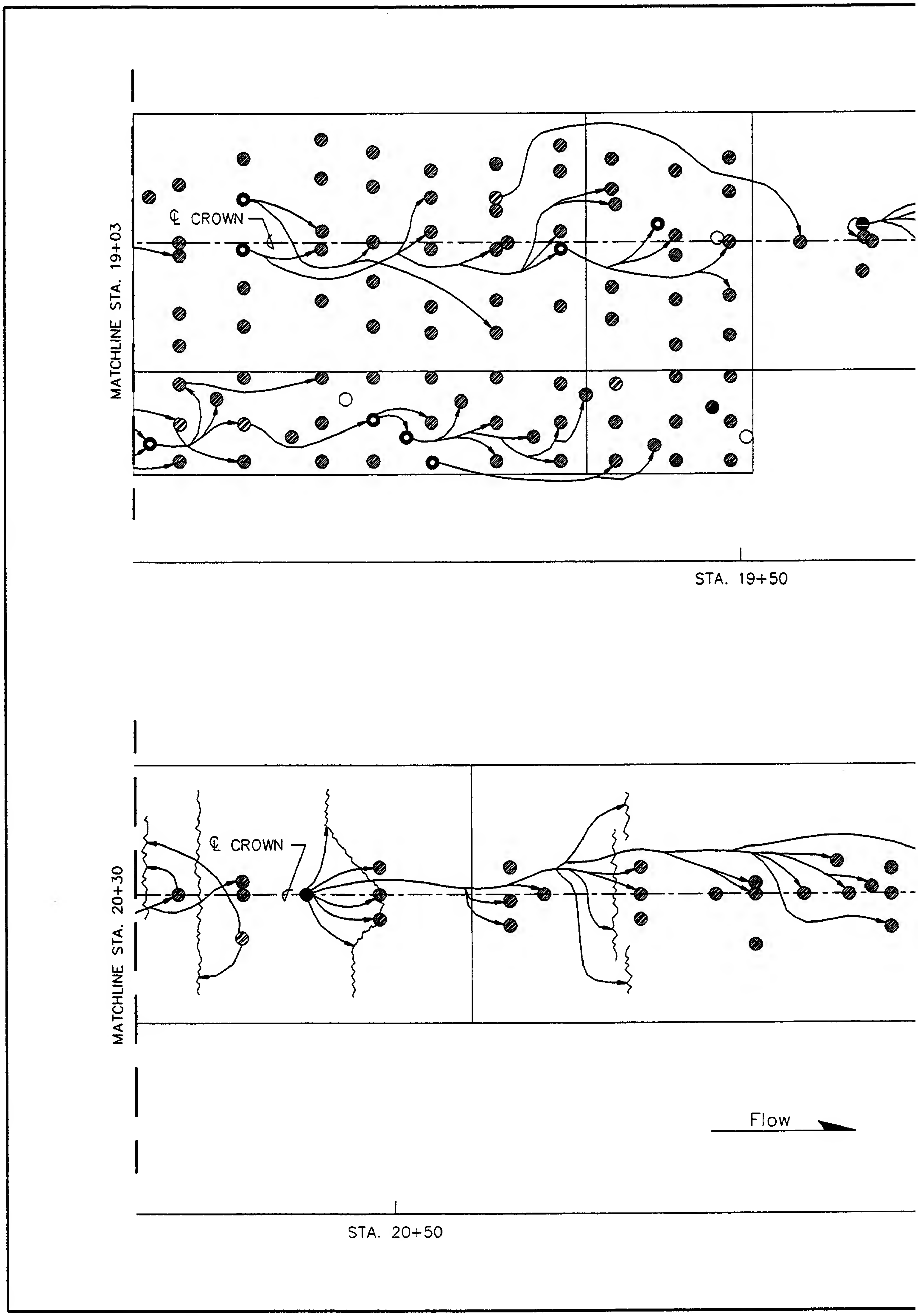


LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

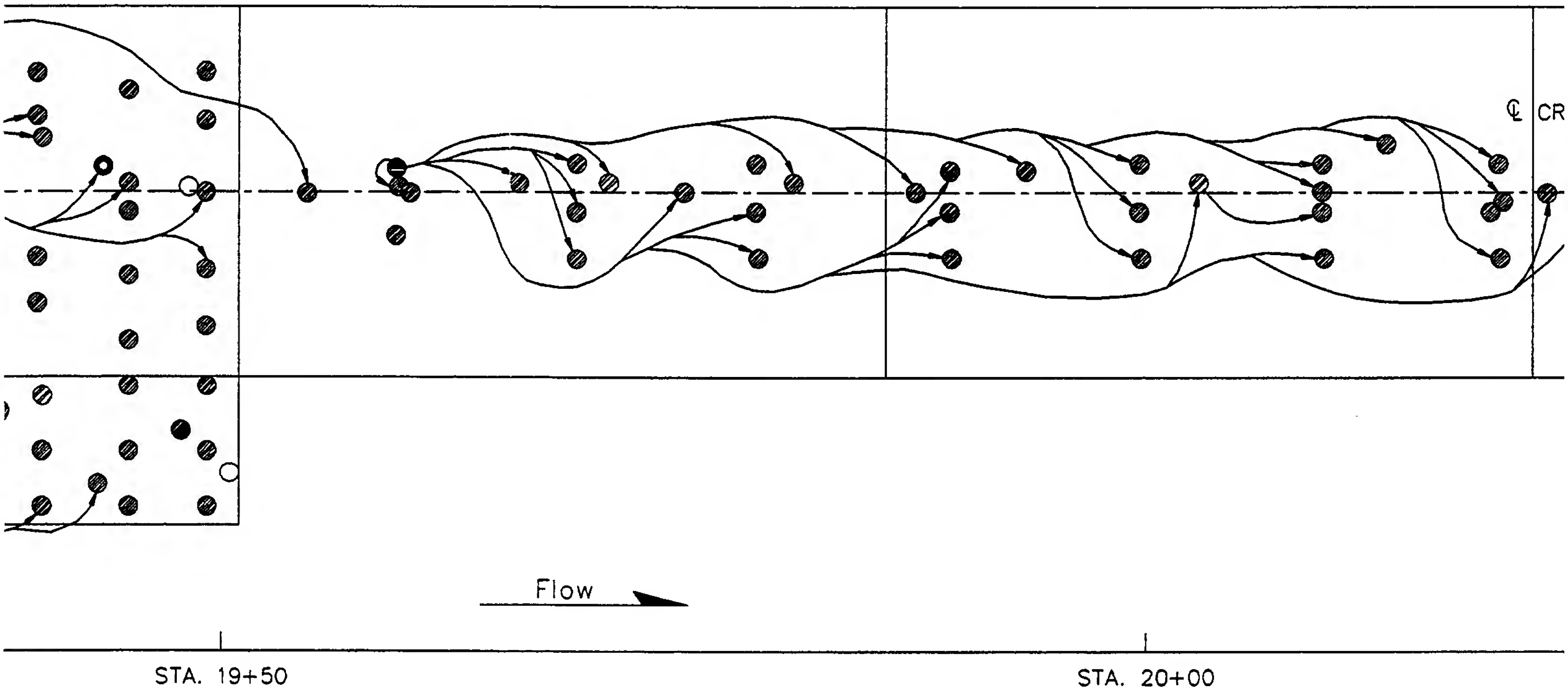
OUTLET WORKS
TUNNEL – CONTACT GROUTING
STA. 16+70 TO STA. 19+03

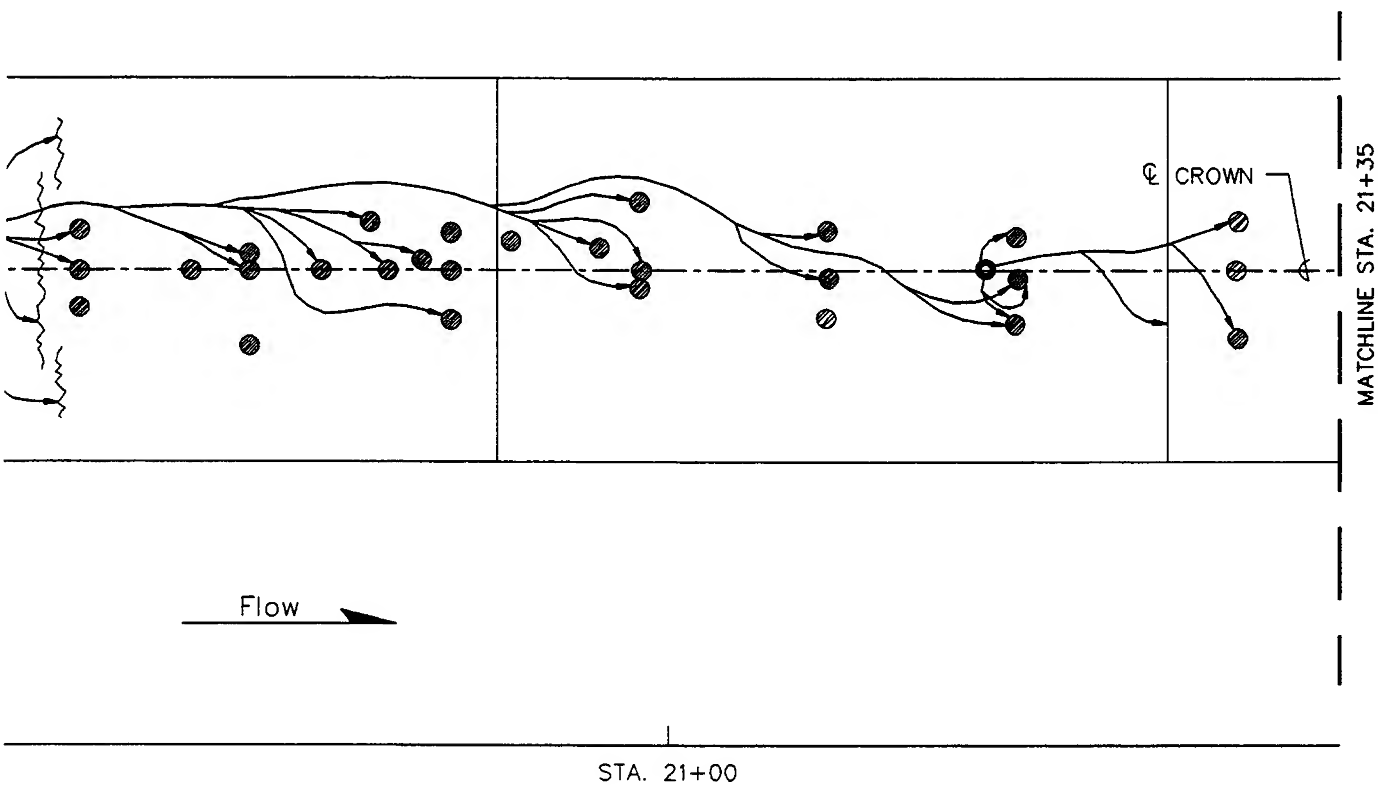
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER
ERE		BAB	PLATE 98



℄ CROWN
MATCHLINE STA. 19+03
STA. 19+50
℄ CROWN
MATCHLINE STA. 20+30
Flow
STA. 20+50

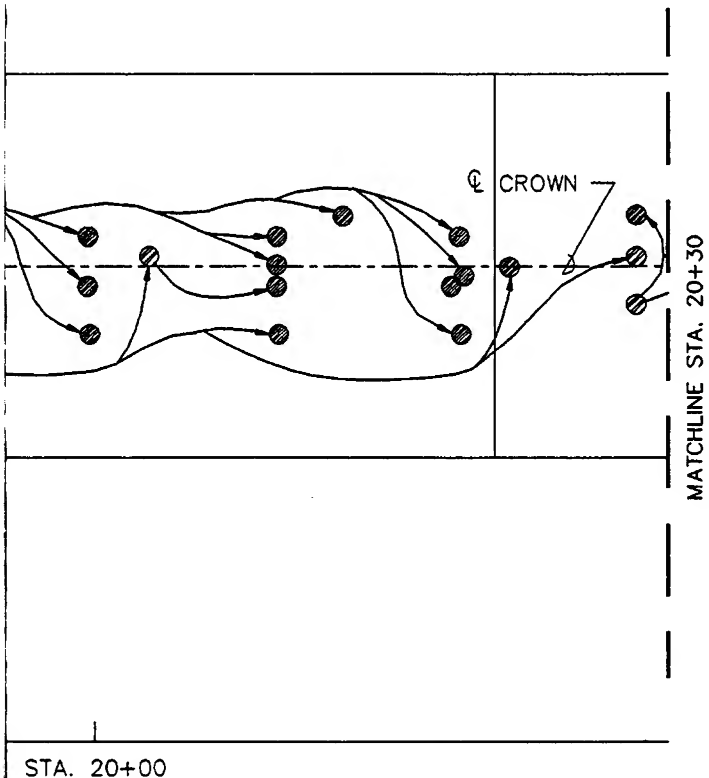


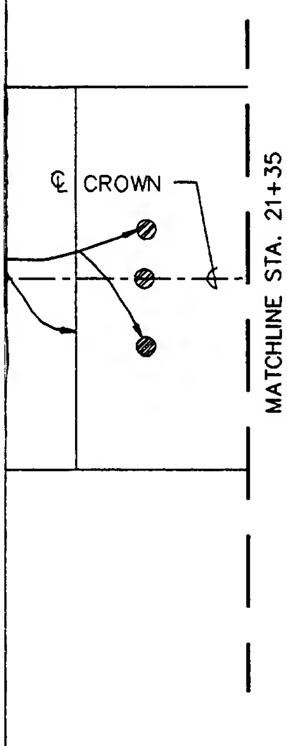


NOTE:
SEE

SUBMITTED:

ERE





NOTE:
SEE LEGEND ON PLATE 94

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

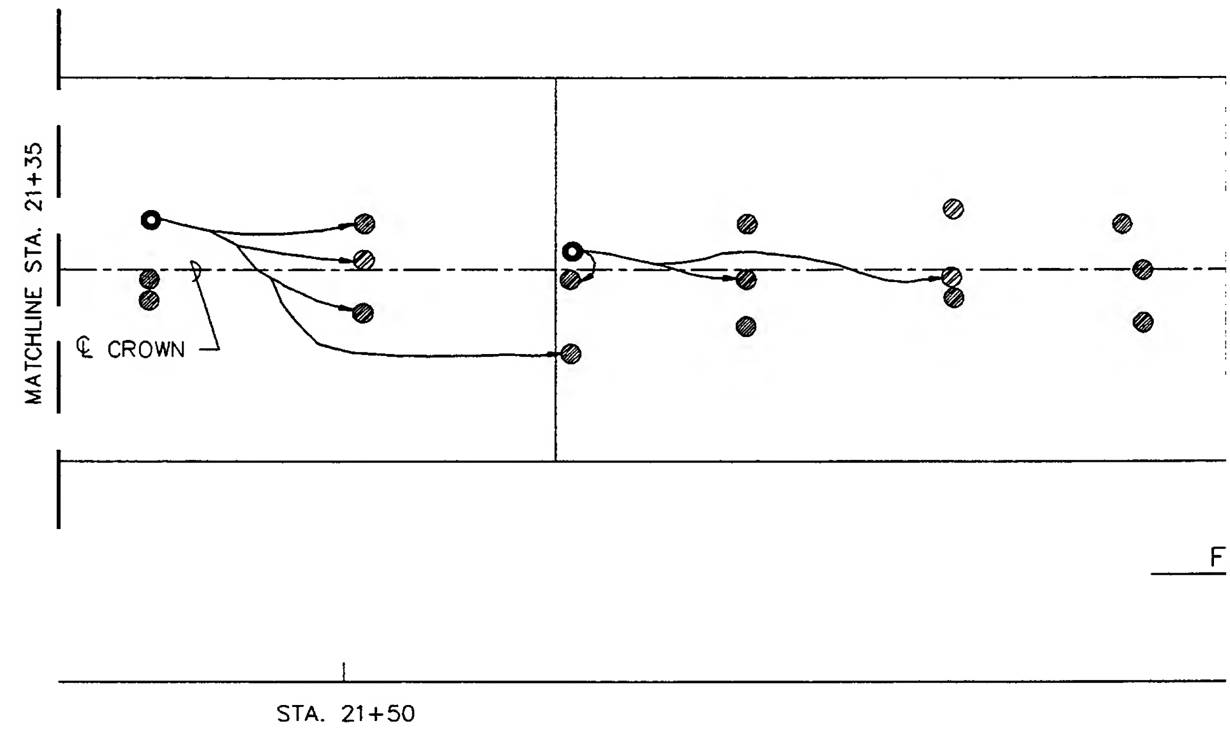
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

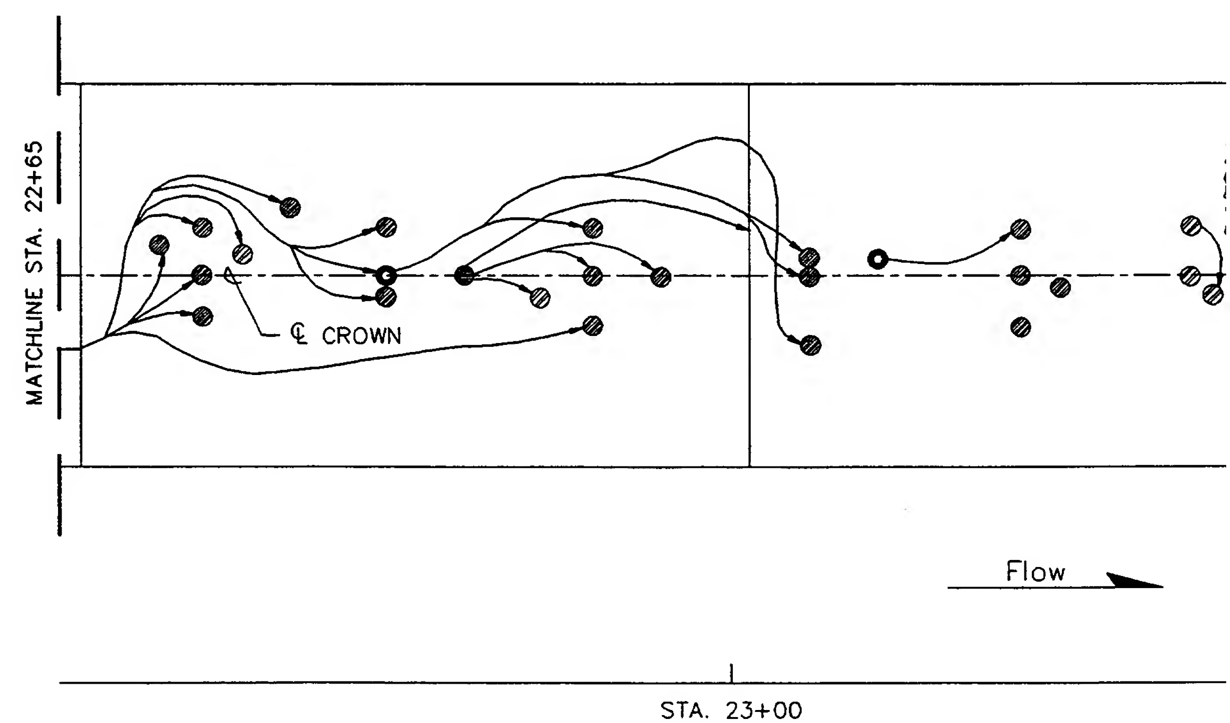
OUTLET WORKS
TUNNEL – CONTACT GROUTING
STA. 19+03 TO STA. 21+35

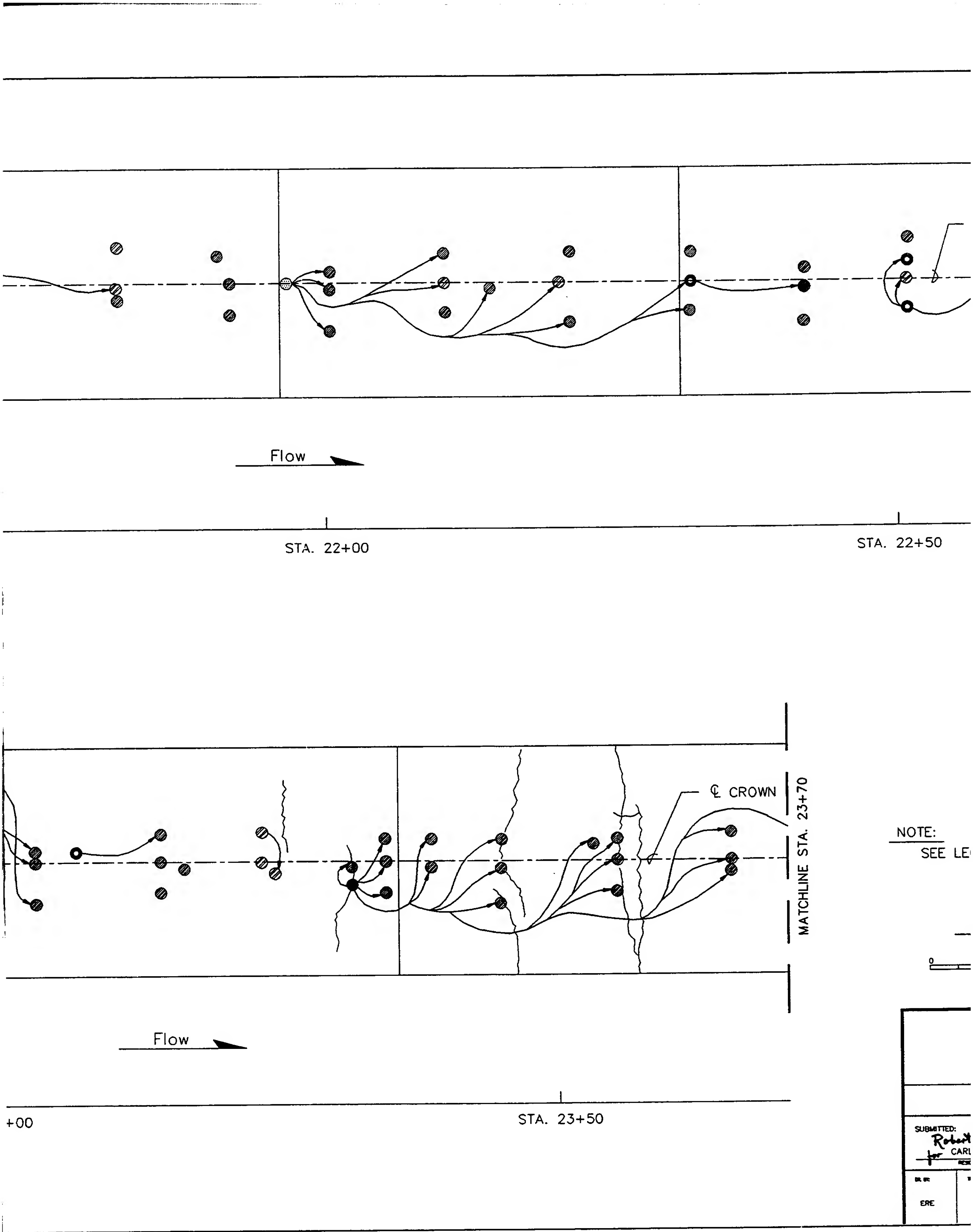
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. ... for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: ... PAUL M. PARSONEAULT, RESIDENT ENGINEER

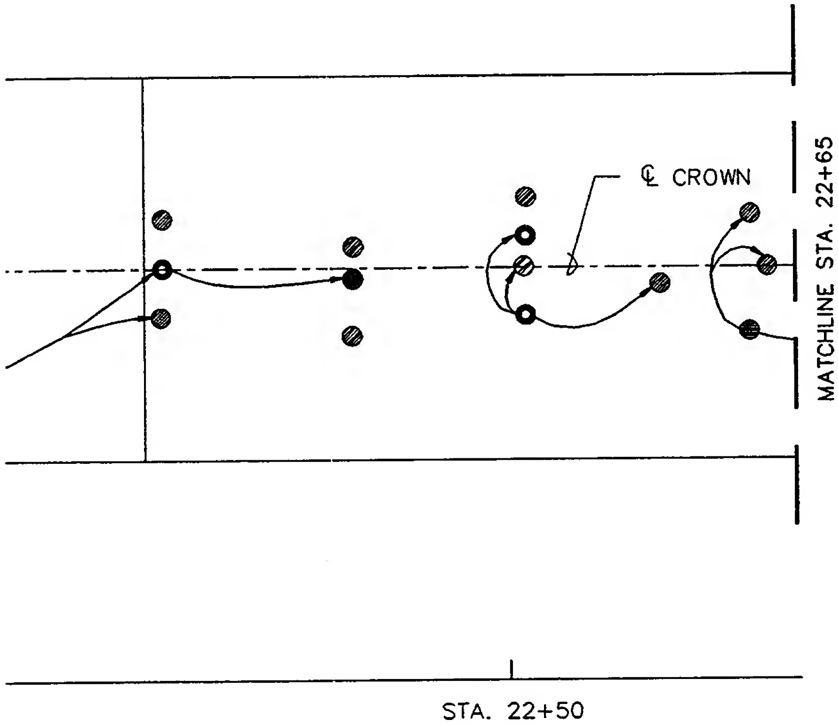
DR. BY:	TR. BY:	CKD. BY:	FILE No.:
ERE		BAB	PLATE 99

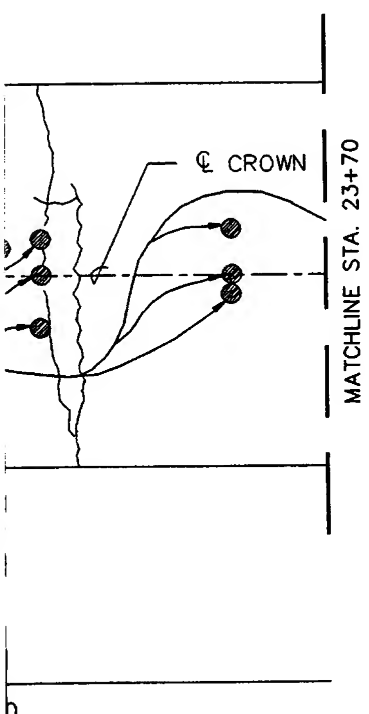

MATCHLINE STA. 21+35
℄ CROWN
F
STA. 21+50


MATCHLINE STA. 22+65
℄ CROWN
Flow
STA. 23+00



Flow
STA. 22+00
STA. 22+50
Flow
℄ CROWN
MATCHLINE STA. 23+70
+00
STA. 23+50
NOTE:
SEE LE
SUBMITTED:
CARL
ERE





NOTE:
SEE LEGEND ON PLATE 94

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

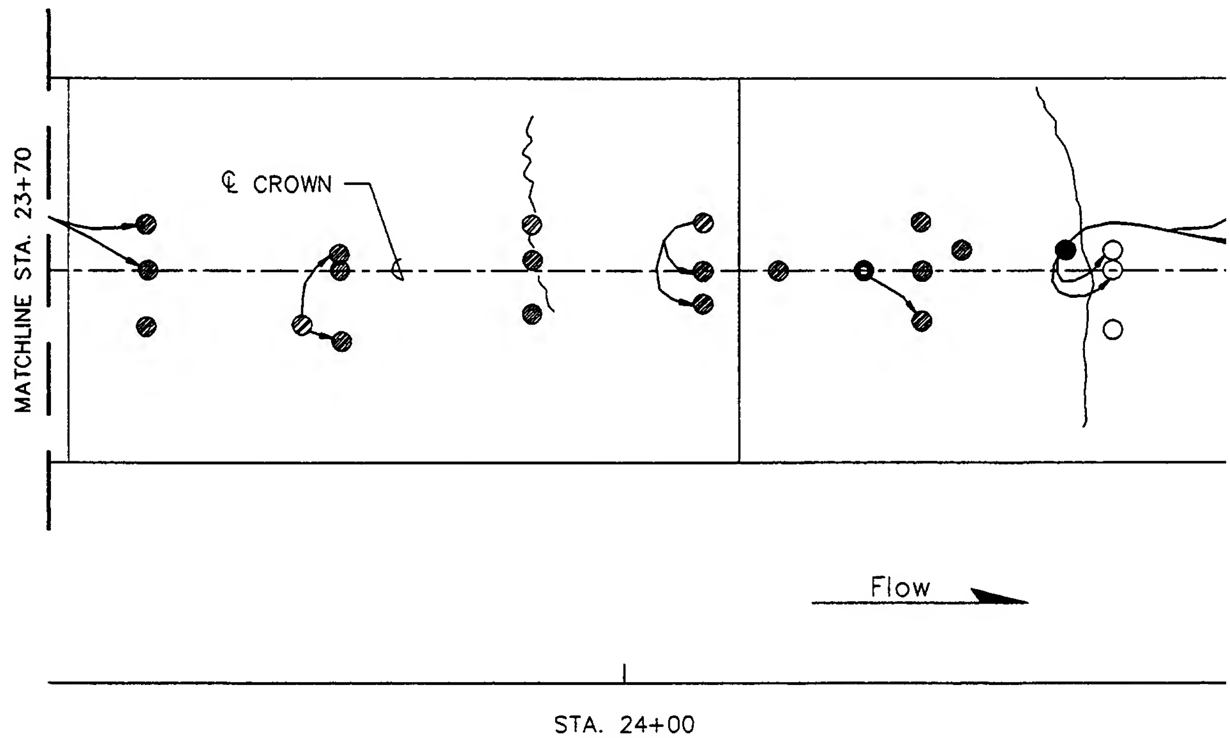
OUTLET WORKS
TUNNEL – CONTACT GROUTING
STA. 21+35 TO STA. 23+70

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

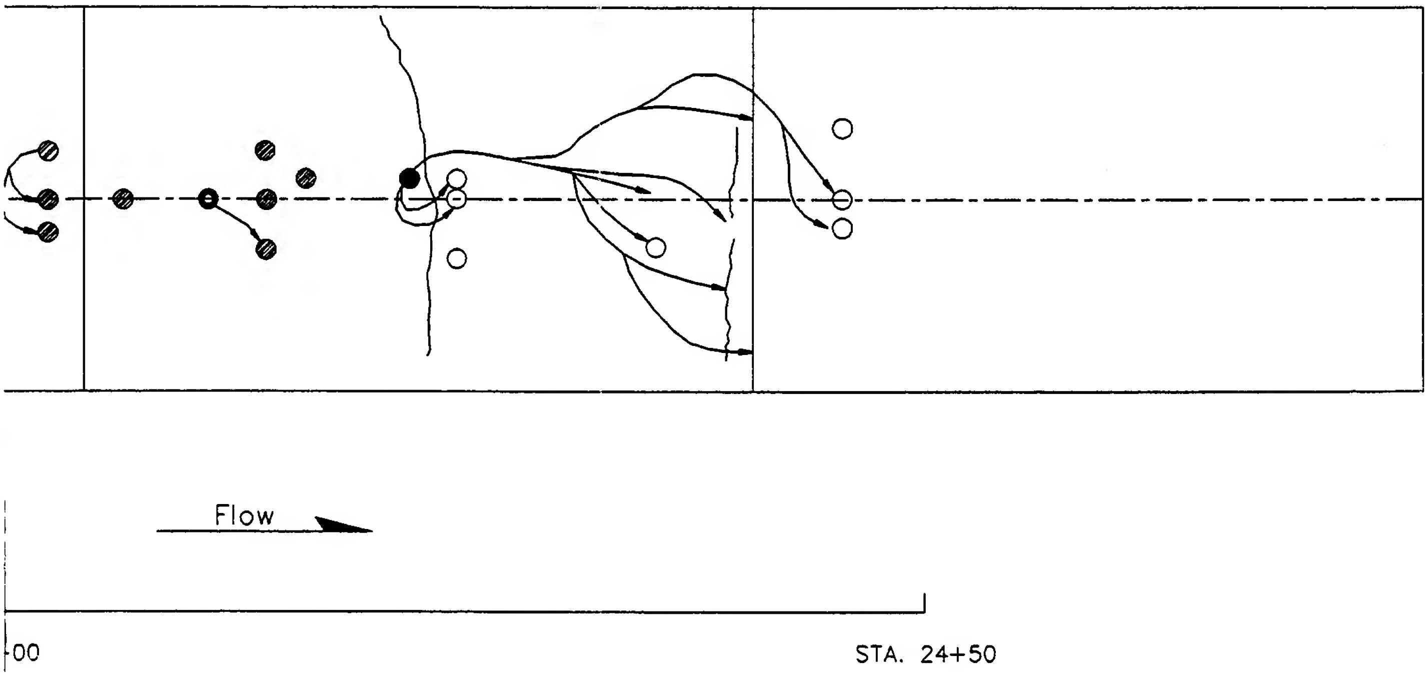
SUBMITTED: Robert L. Trent for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE		BAB	PLATE 100



MATCHLINE STA. 23+70
℄ CROWN
Flow
STA. 24+00



NC

NOTE:

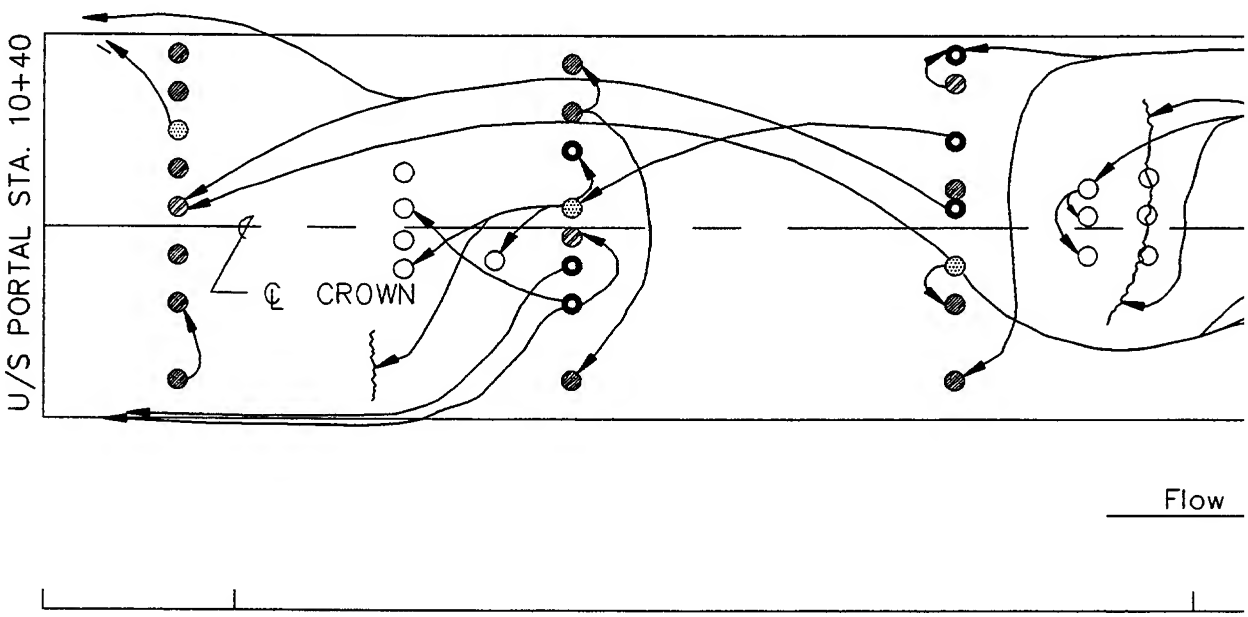
SEE LEGEND ON PLATE 94

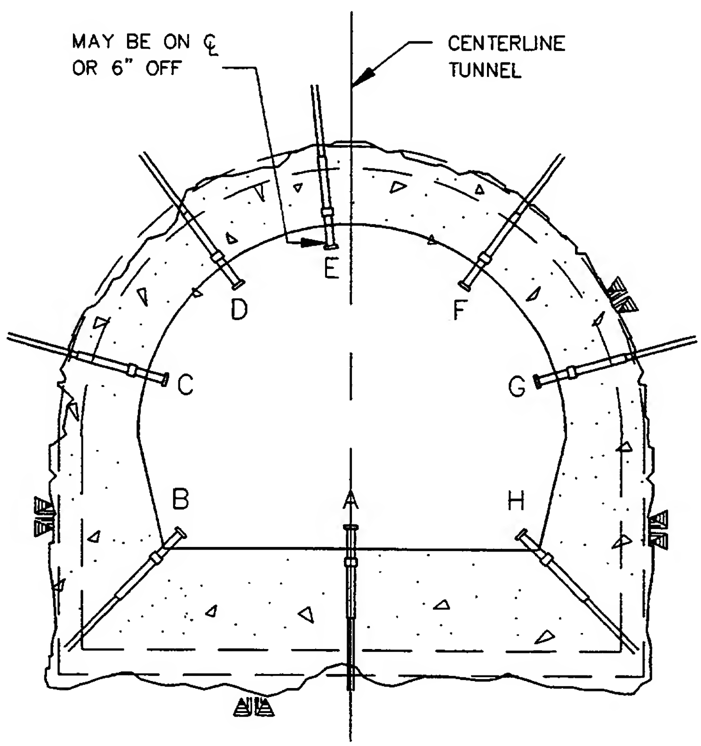
GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

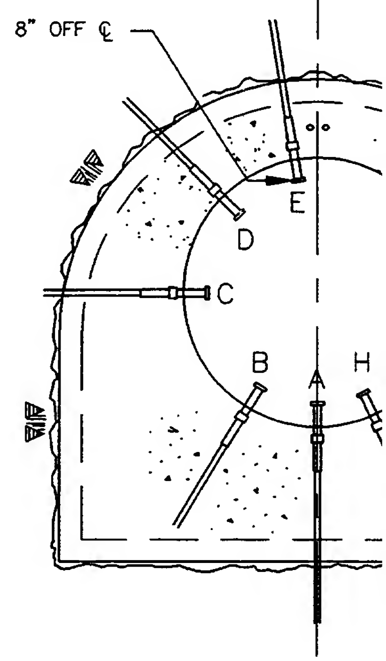
LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH OUTLET WORKS TUNNEL – CONTACT GROUTING STA. 23+70 TO STA. 24+50			
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA			
SUBMITTED: Robert L. [illegible] for CARL E. COLE, RESIDENT GEOLOGIST		APPROVED: for John [illegible] PAUL M. PARSONEAULT, RESIDENT ENGINEER	
DR. BY: ERE	TR. BY:	CKD. BY: BAB	FILE No: PLATE 101





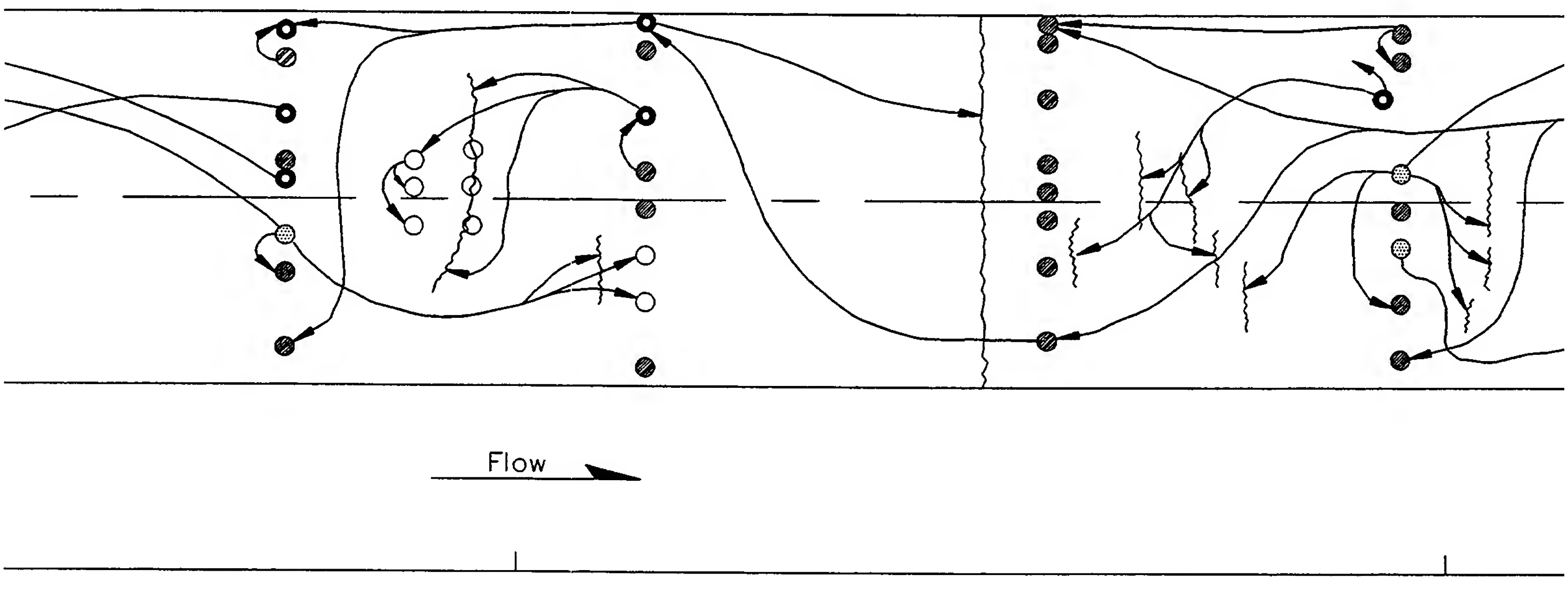
UPSTREAM TUNNEL
(UPSTREAM PORTAL TO E.C.C.)

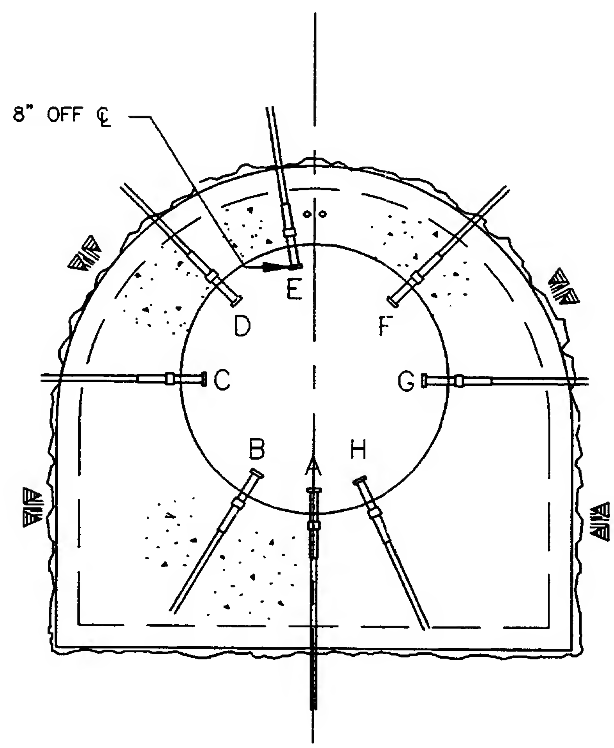
VIEW LOOKING DOWNSTREAM



DOWNSTREAM T
(E.C.C. TO STA. 1

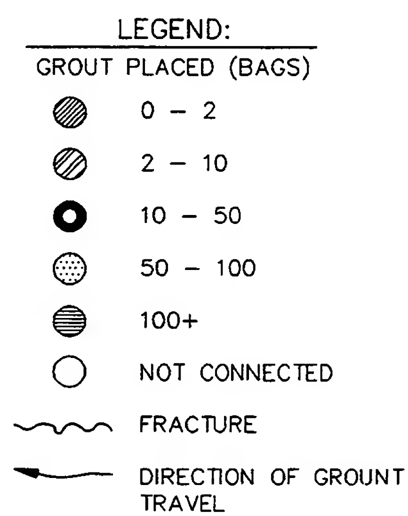
VIEW LOOKING DOWNS

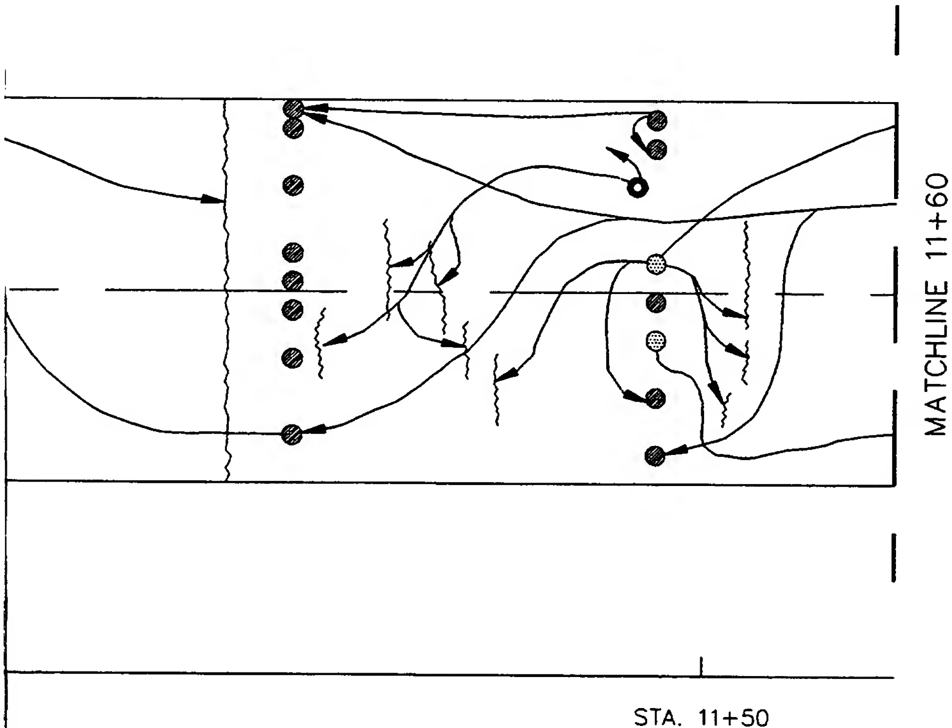




DOWNSTREAM TUNNEL
(E.C.C. TO STA. 19+50)

VIEW LOOKING DOWNSTREAM





LEGEND:

GROUT PLACED (BAGS)

- 0 – 2
- 2 – 10
- 10 – 50
- 50 – 100
- 100+
- NOT CONNECTED
- FRACTURE
- DIRECTION OF GROUNT TRAVEL

GRAPHIC SCALE:

0 10' 20'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

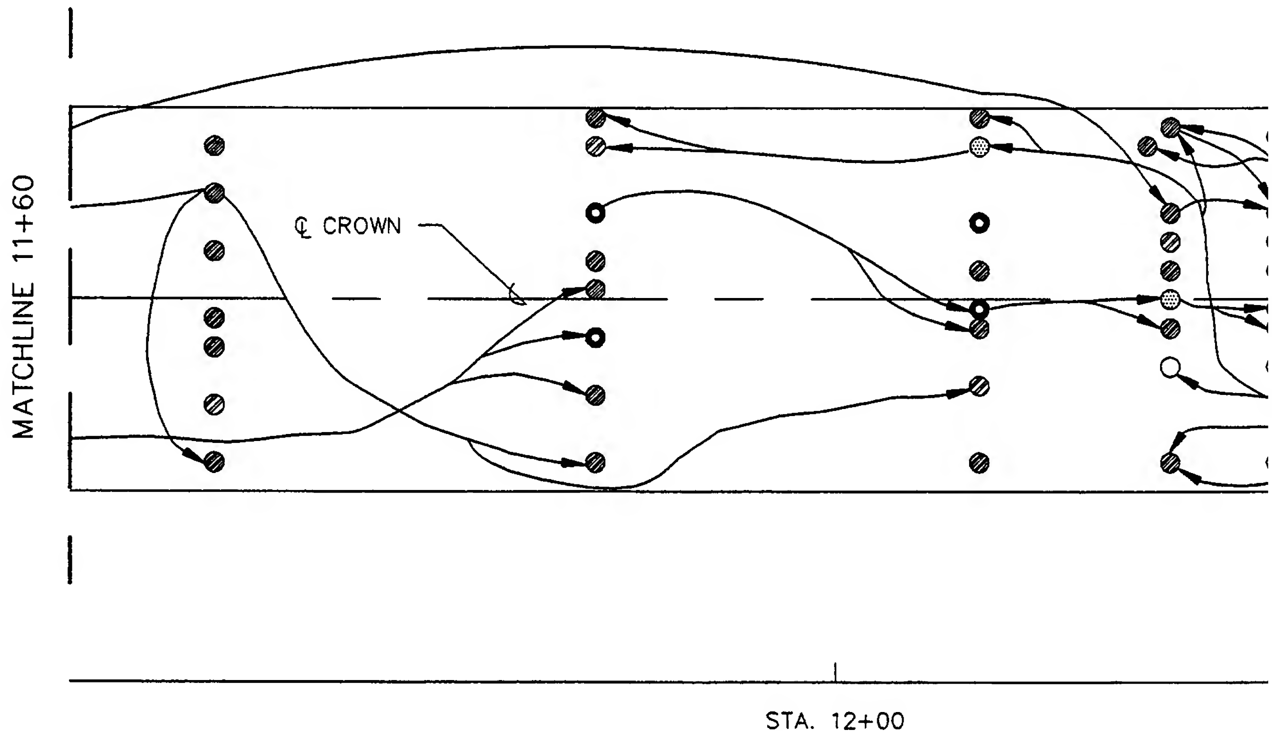
OUTLET WORKS

TUNNEL – CONSOLIDATION GROUTING
STA. 10+47 TO STA. 11+60

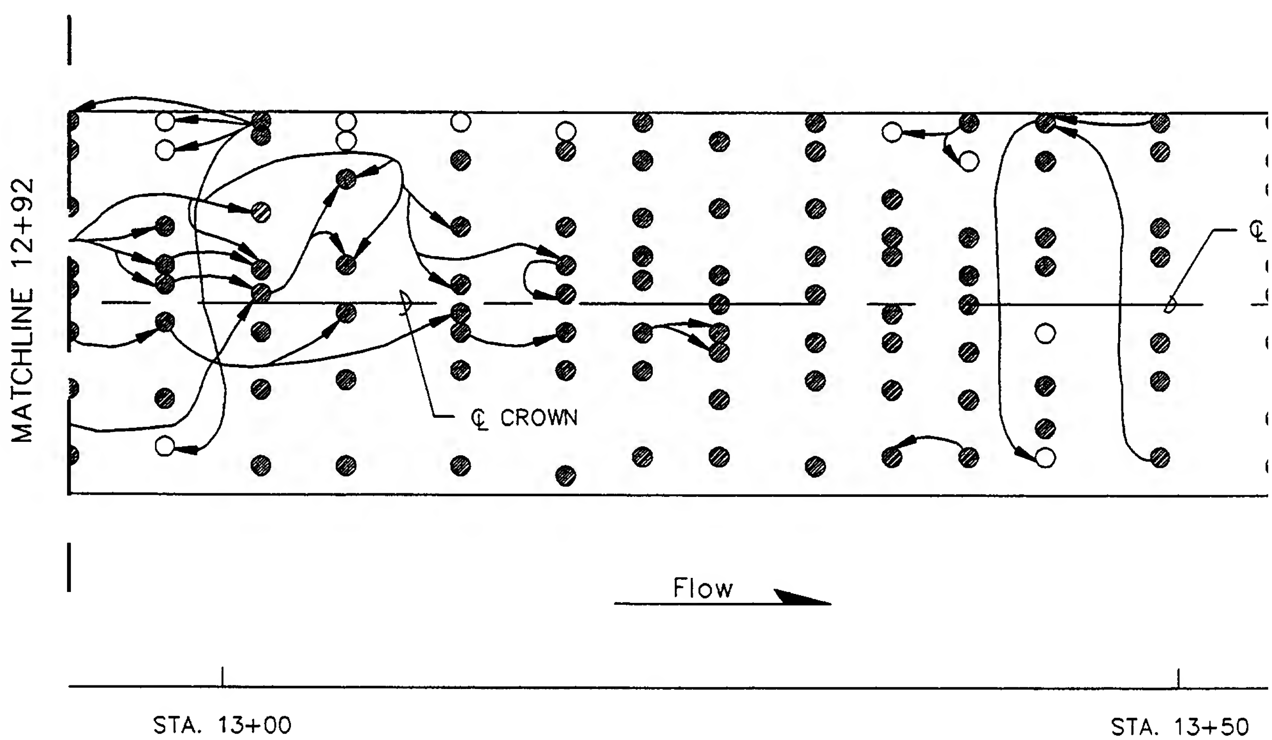
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

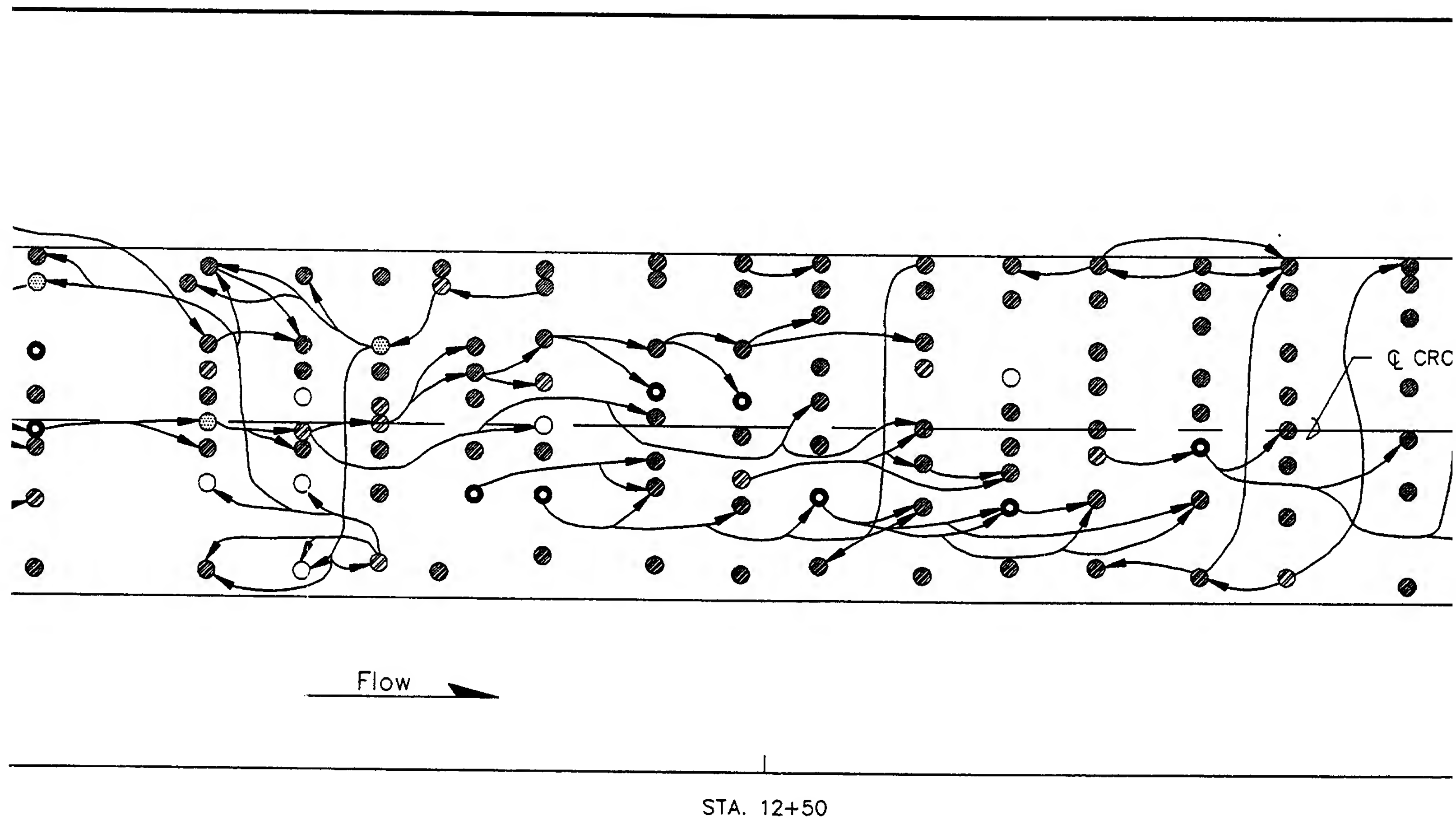
ERE		BAB	PLATE 102

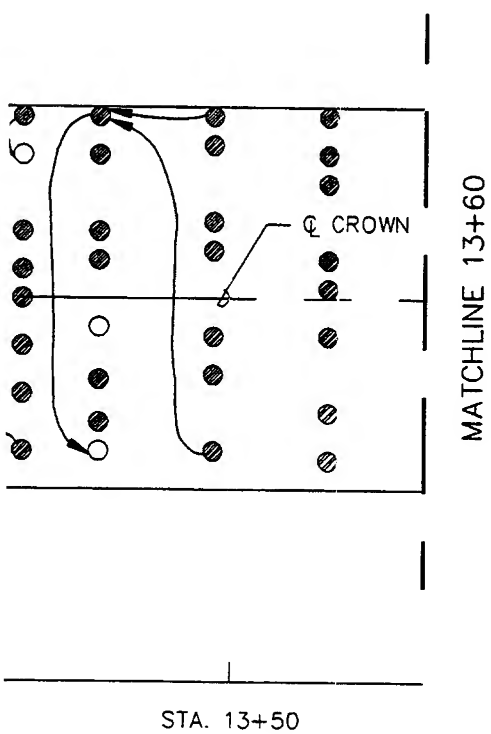


MATCHLINE 11+60
℄ CROWN
STA. 12+00



MATCHLINE 12+92
℄ CROWN
℄
Flow
STA. 13+00
STA. 13+50





NOTE:
SEE LEGEND ON PLAT

GRAPHIC SCA

0 10'

(SCALE IN FEET)

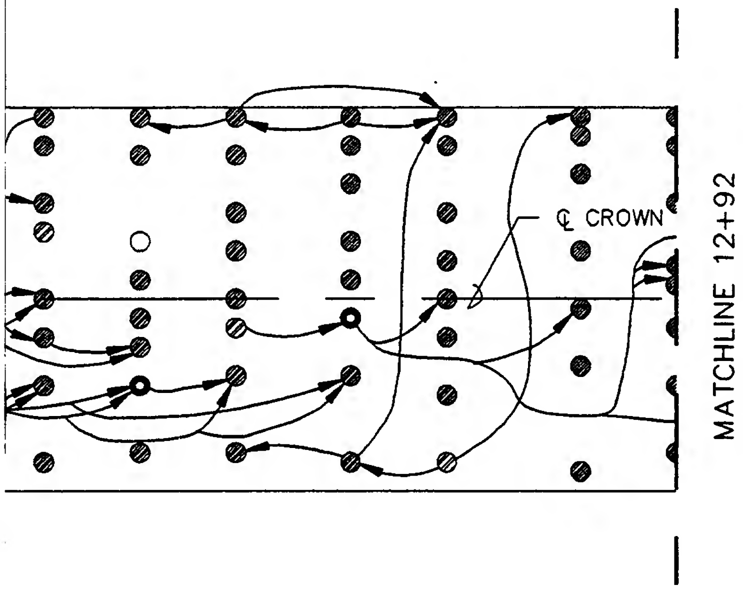
LITTLE DELL
SALT LAKE CITY ST

OUTLET WO
TUNNEL – CONSOLID
STA. 11+60 TO

DEPARTMENT OF
SACRAMENTO DISTRICT, CO
SACRAMENTO, CA

SUBMITTED:
Robert L. Frost
for CARL E. COLE
RESIDENT GEOLOGIST

ERE		BAB	

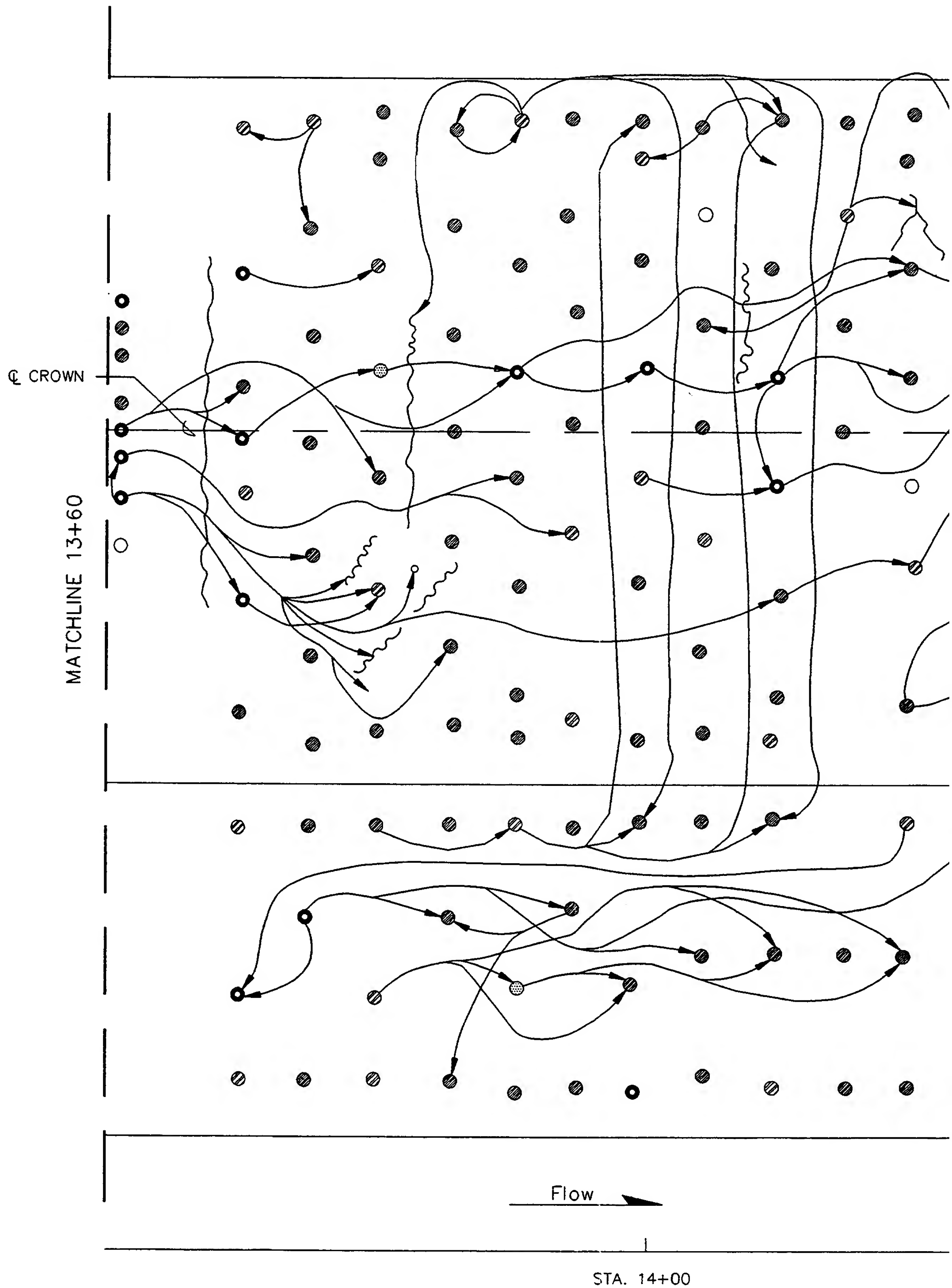


NOTE:
SEE LEGEND ON PLATE 102

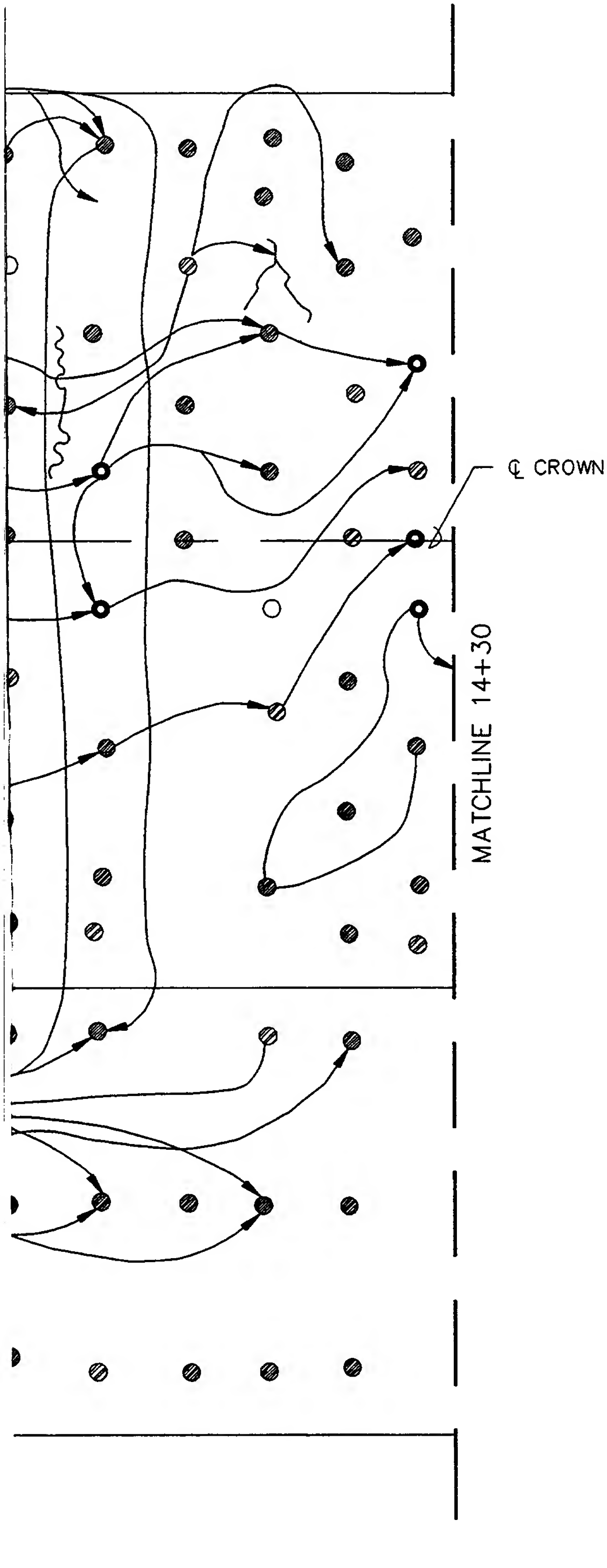
GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

LITTLE DELL LAKE SALT LAKE CITY STREAMS, UTAH OUTLET WORKS TUNNEL – CONSOLIDATION GROUTING STA. 11+60 TO STA. 13+60			
DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA			
SUBMITTED: Robert L. [illegible] for CARL E. COLE, RESIDENT GEOLOGIST		APPROVED: for [illegible] PAUL M. PARSONEAULT, RESIDENT ENGINEER	
ERE		BAB	PLATE 103



℄ CROWN
MATCHLINE 13+60
Flow
STA. 14+00



NOTE:
SEE LEGEND ON PLATE 102

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

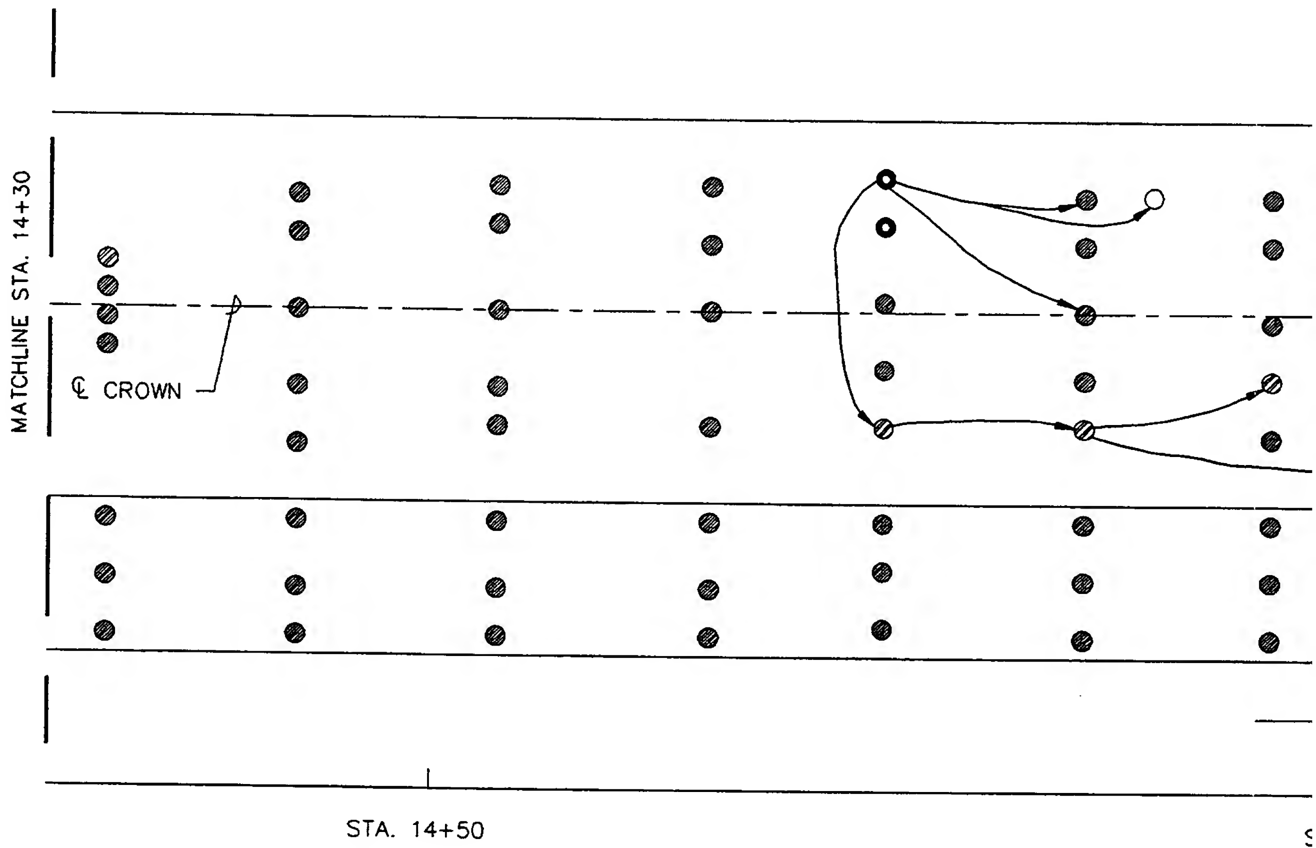
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

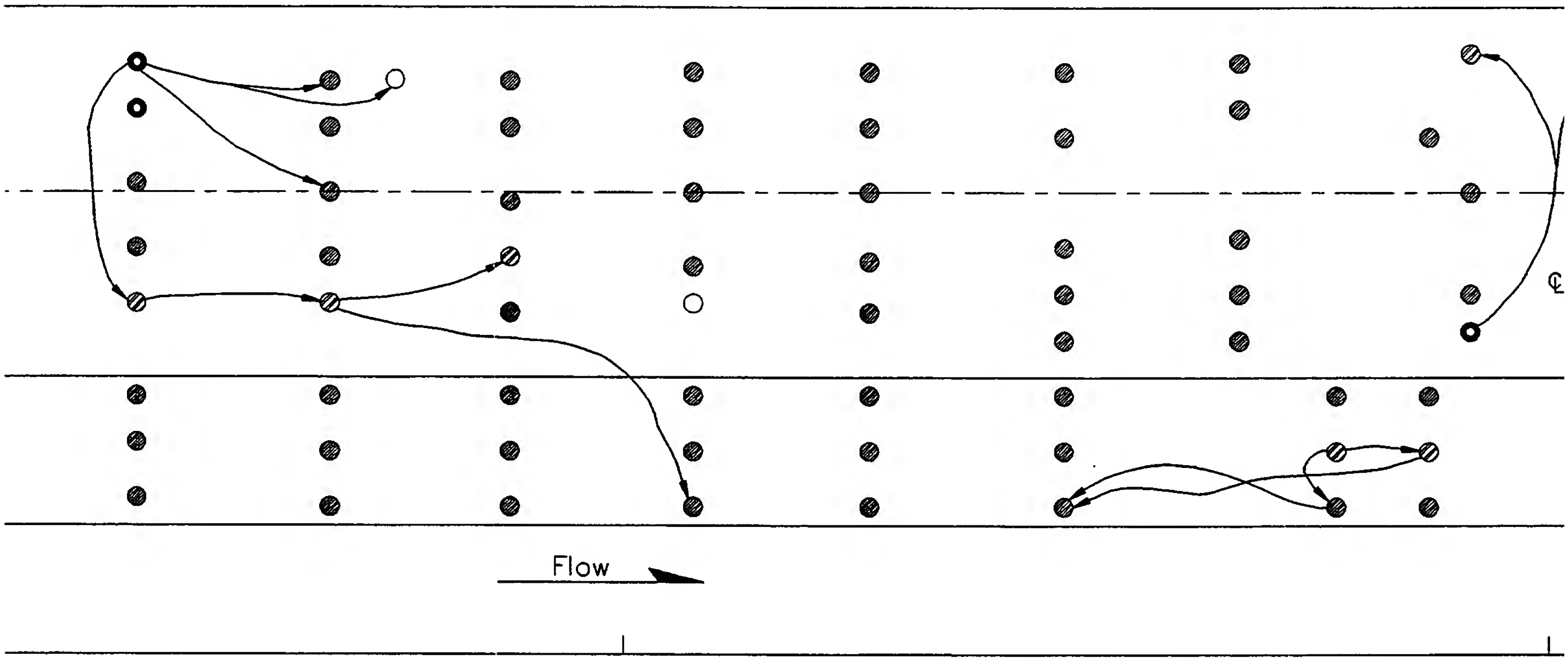
OUTLET WORKS

TUNNEL – CONSOLIDATION GROUTING
STA. 13+60 TO STA. 14+30

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: for CARL E. COLE, RESIDENT GEOLOGIST		APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER	
DR. BY: ERE	TR. BY:	CKD. BY: BAB	FILE NO: PLATE 104


MATCHLINE STA. 14+30
℄ CROWN
STA. 14+50



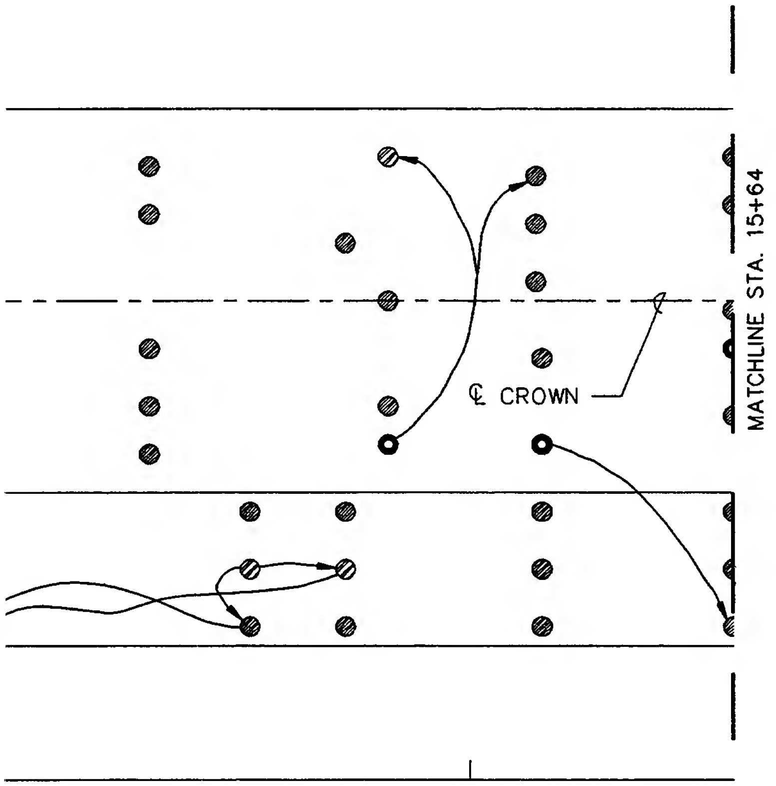
STA. 15+00

STA. 15-

NOTE:
SEE LE

SUBMITTED:
CARL

ERE



NOTE:
SEE LEGEND ON PLATE 102

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

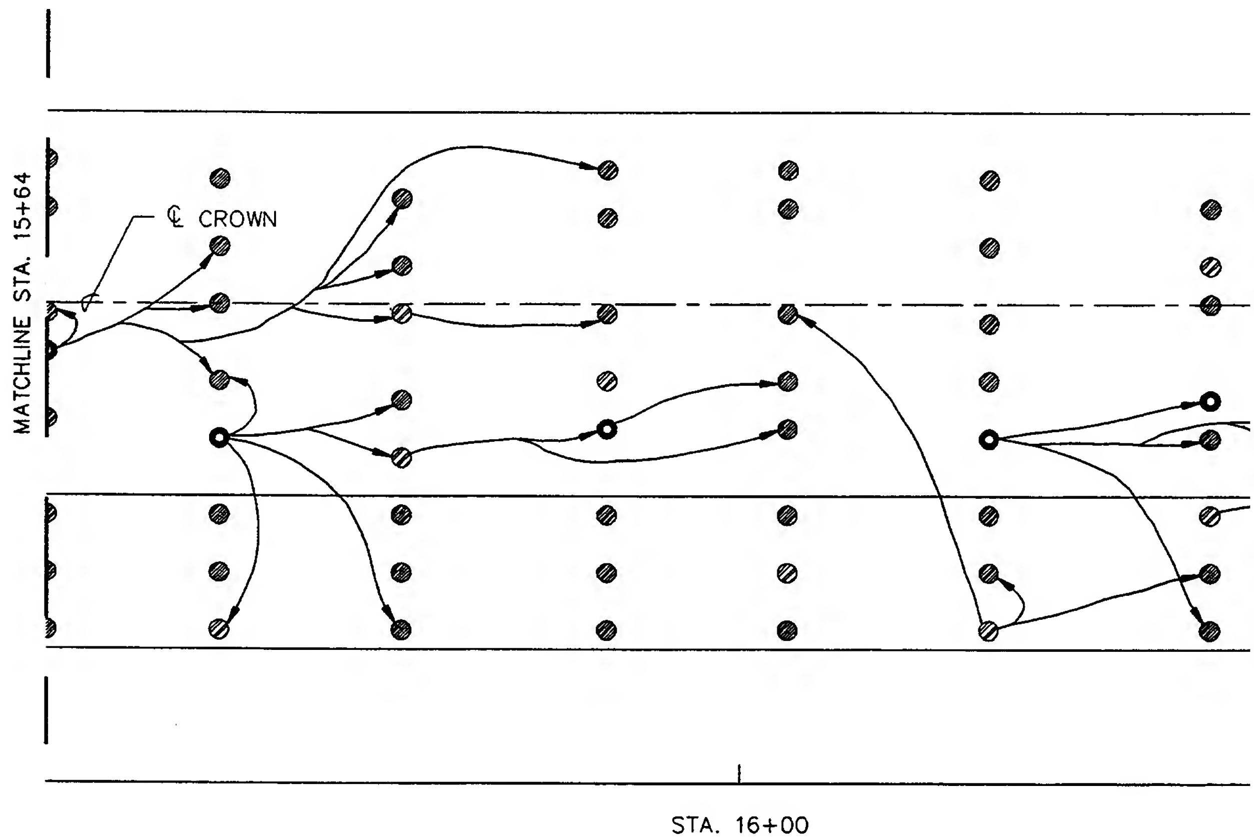
OUTLET WORKS

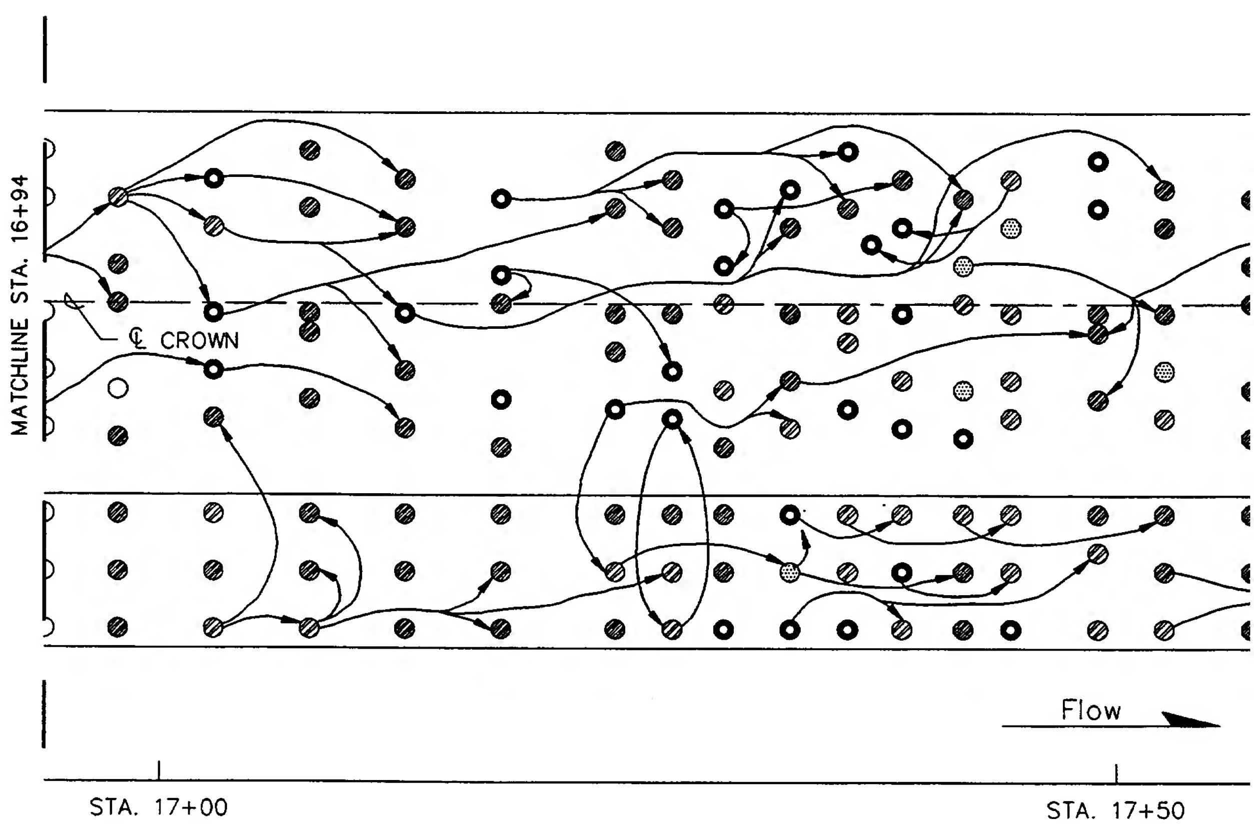
TUNNEL – CONSOLIDATION GROUTING
STA. 14+30 TO STA. 15+64

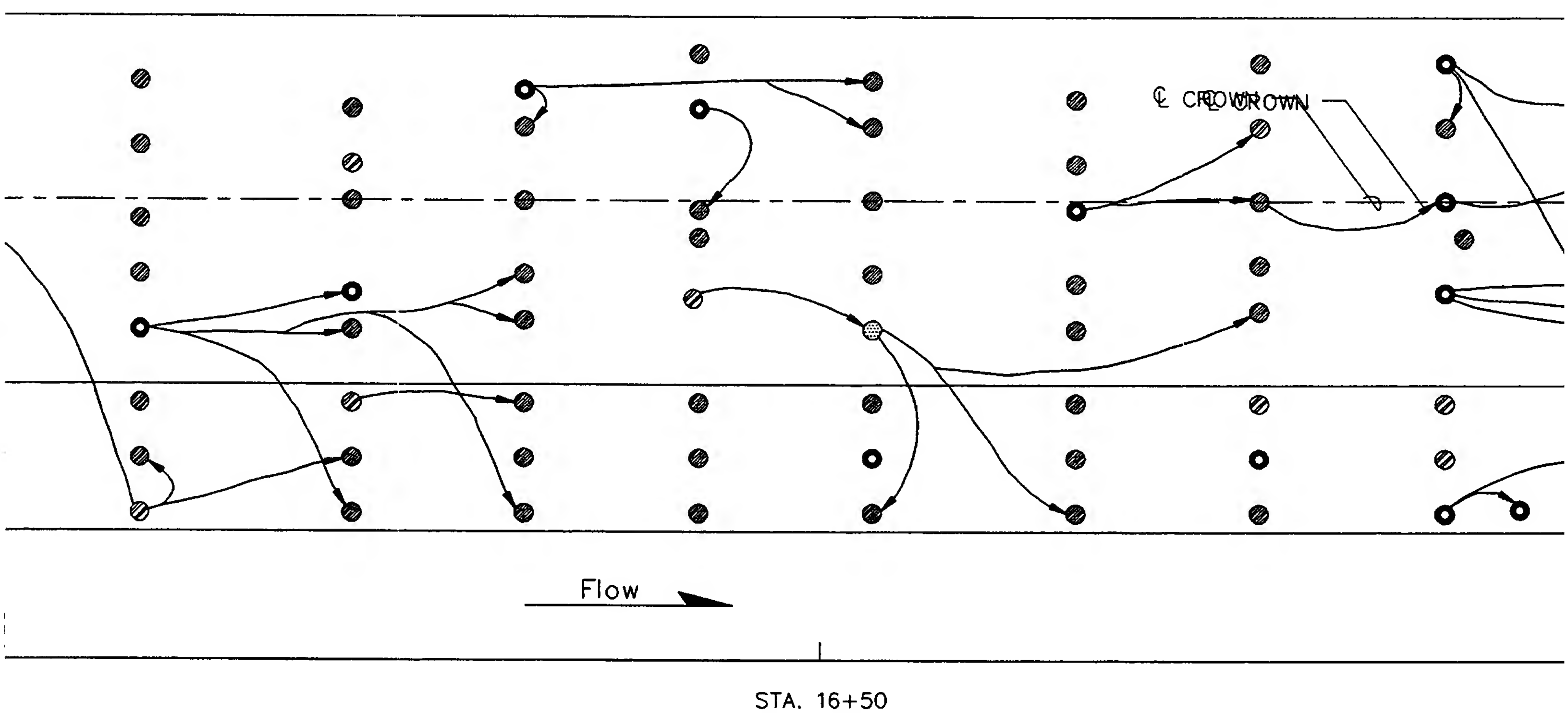
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

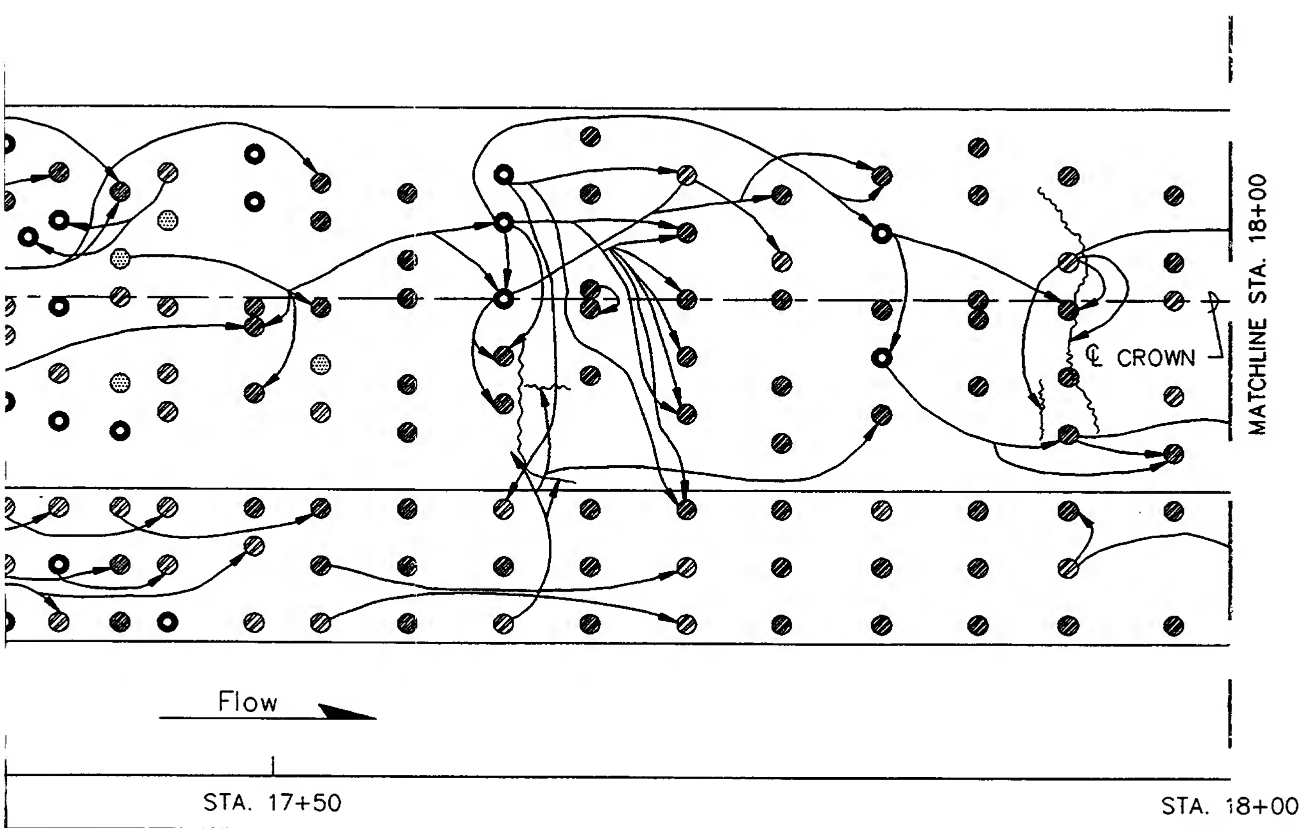
SUBMITTED:	APPROVED:
Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST	for [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	CK. BY:	CHK. BY:	FILE No.:
ERE		BAB	PLATE 105


MATCHLINE STA. 15+64
℄ CROWN
STA. 16+00


MATCHLINE STA. 16+94
℄ CROWN
Flow
STA. 17+00
STA. 17+50





NOTE:
SEE LEGEND ON

GRAPH

0

(SCAL

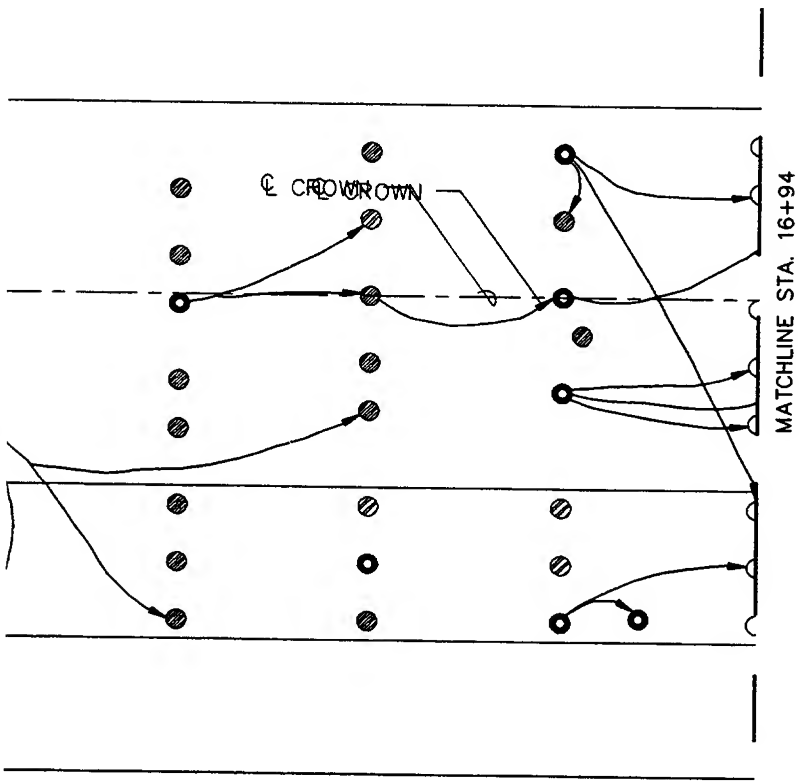
UT
SALT LAK

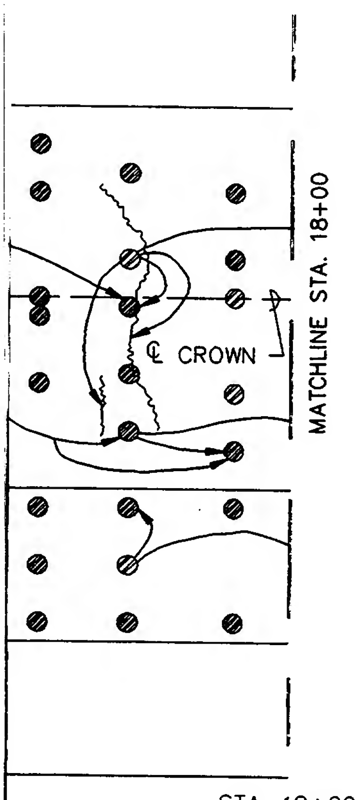
O
TUNNEL - CO
STA. 15+

DEPART
SACRAMENTO D
SACR

SUBMITTED:
Robert L. Trent
for CARL E. COLE
RESIDENT GEOLOGIST

DR. BY:	CK. BY:	GEOL. BY:
ERE		BAI





NOTE:
SEE LEGEND ON PLATE 102

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

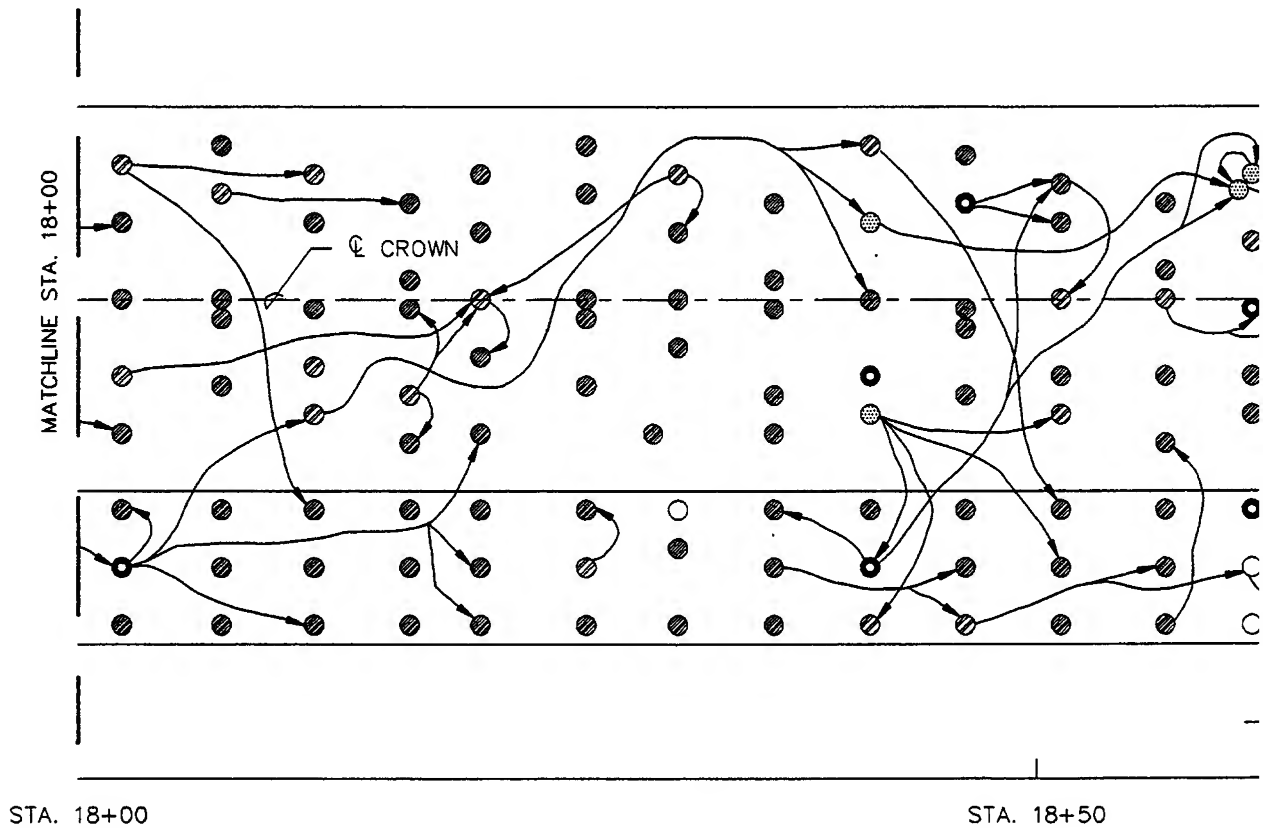
LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

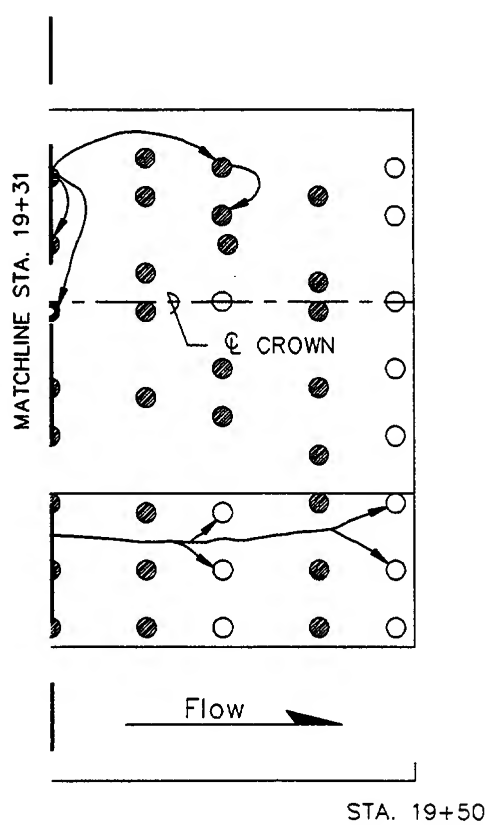
OUTLET WORKS
TUNNEL – CONSOLIDATION GROUTING
STA. 15+64 TO STA. 18+00

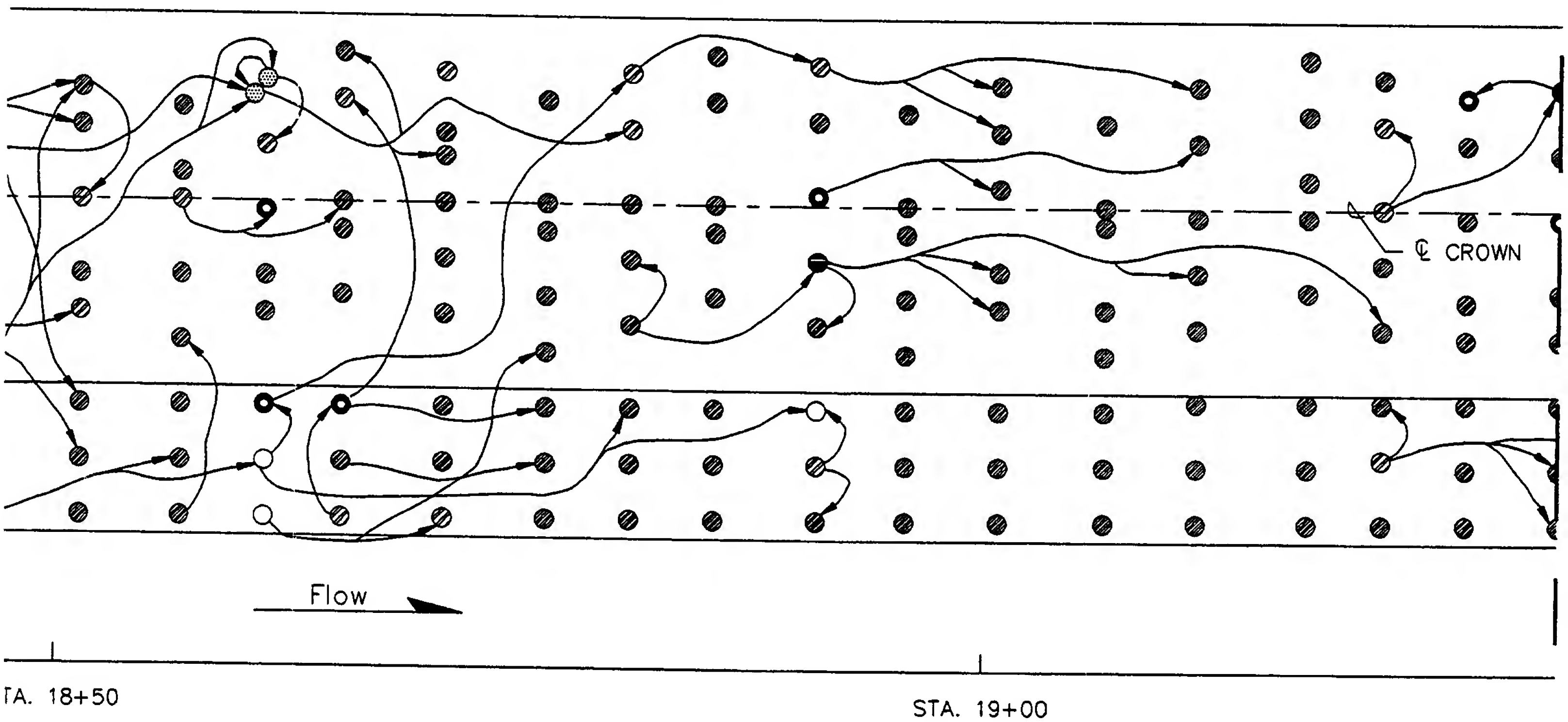
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Frost for CARL E. COLE, RESIDENT GEOLOGIST	APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE NO.:
ERE		BAB	PLATE 106


MATCHLINE STA. 18+00
℄ CROWN
STA. 18+00
STA. 18+50


MATCHLINE STA. 19+31
℄ CROWN
Flow
STA. 19+50



NOTE:
SEE LEGEND ON PLATE

GRAPHIC SCALE:

0 10'
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS

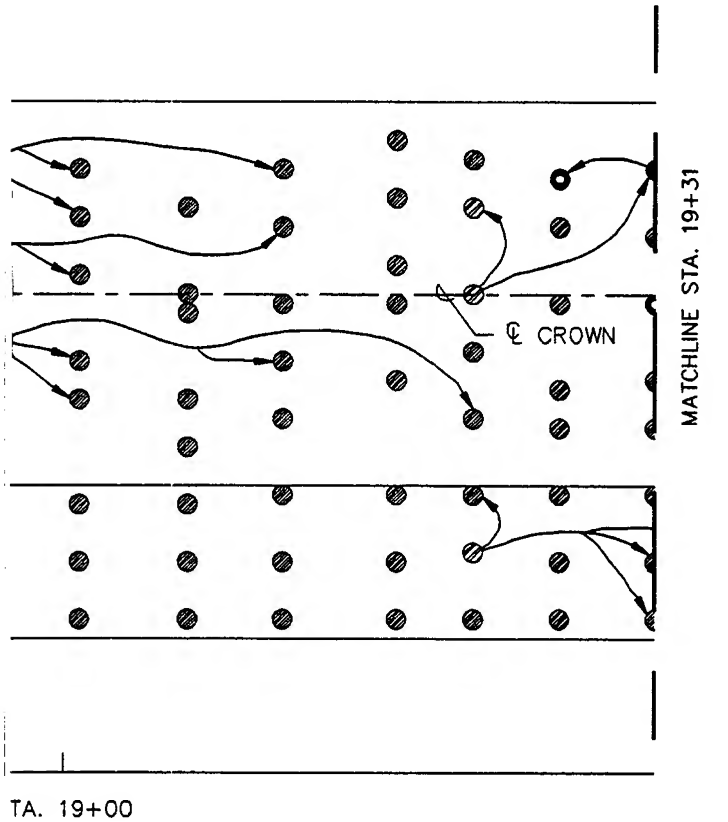
OUTLET WORKS
TUNNEL – CONSOLIDATIO
STA. 18+00 TO STA.

DEPARTMENT OF THE
SACRAMENTO DISTRICT, CORPS OF
SACRAMENTO, CALIFORN

SUBMITTED:
Robert L. [illegible]
for CARL E. COLE
RESIDENT GEOLOGIST

APPR
PA

ERE		BAB	



NOTE:
SEE LEGEND ON PLATE 102

GRAPHIC SCALE:

0 10' 20'
(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

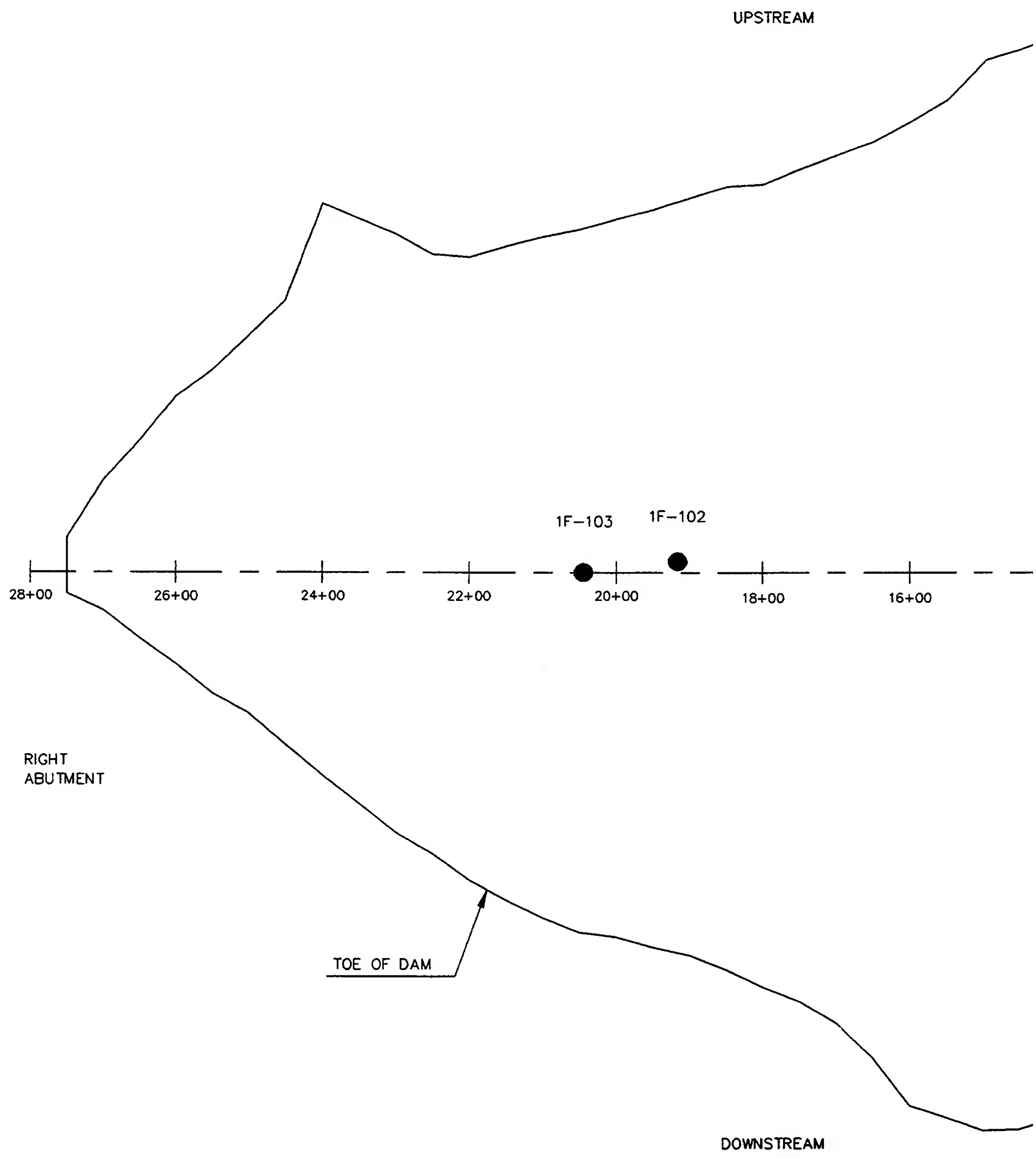
OUTLET WORKS
TUNNEL – CONSOLIDATION GROUTING
STA. 18+00 TO STA. 19+50

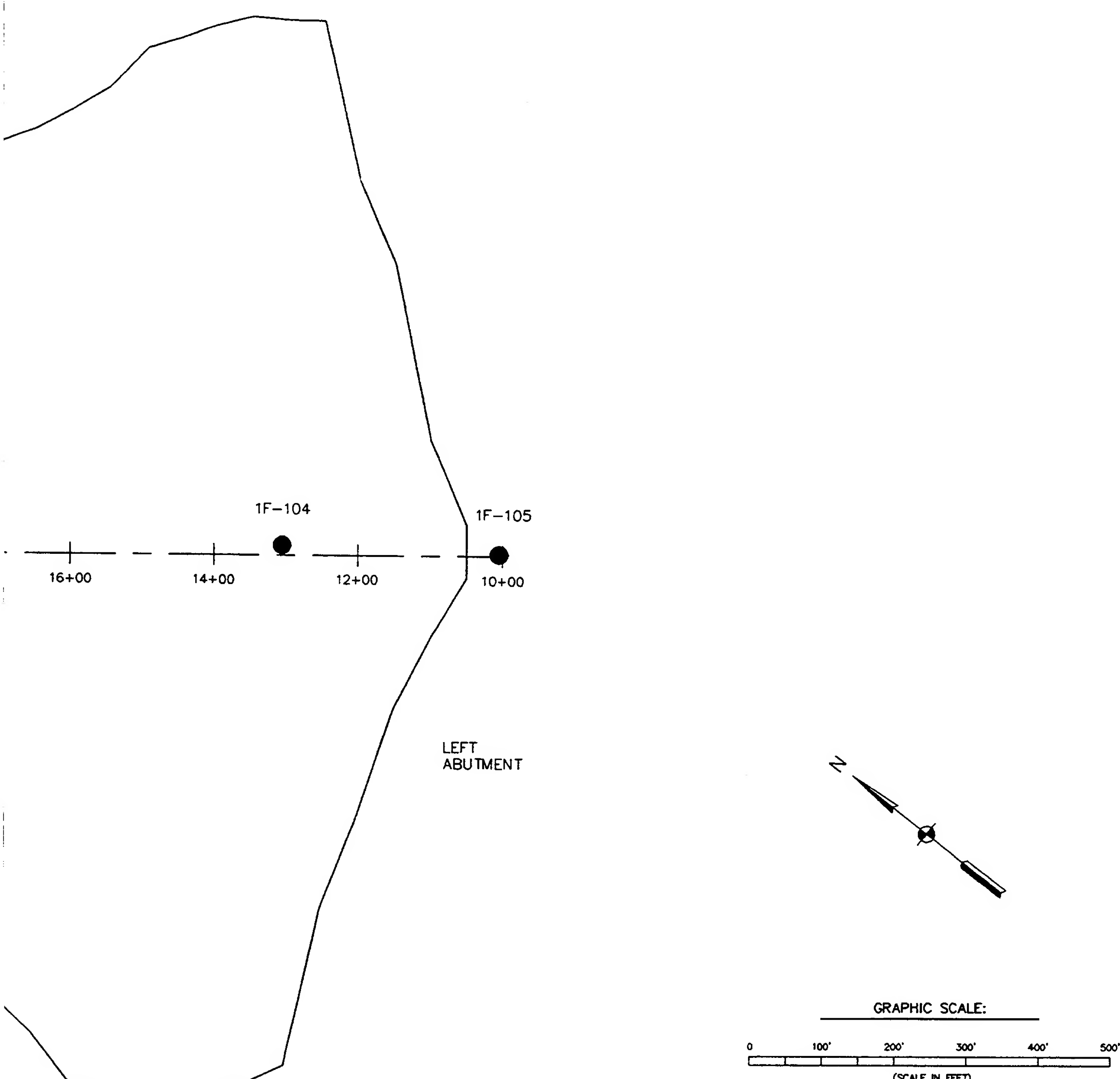
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. [signature] for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: [signature] for PAUL M. PARSONEAULT, RESIDENT ENGINEER

ERE | | BAB | PLATE 107


UPSTREAM
1F-103
1F-102
28+00
26+00
24+00
22+00
20+00
18+00
16+00
RIGHT ABUTMENT
TOE OF DAM
DOWNSTREAM



LEGEND:

● EXPLORATORY DRILL HOLE

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

MAIN DAM
EMBANKMENT PLAN
LOCATION OF EXPLORATIONS

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

DR. BY:	TR. BY:	CKD. BY:	FILE No.:
ERE		BAB	PLATE 108

1F-102 INCLINED 60° AT N39°W

RECOVERY %		N887,596	E1,943,831
WATER	CORE	ELEV.	DEPTH IN FT.

100 0 100

5596.0

WATER	CORE
100%	85%
100%	100%
100%	100%
100%	100%
100%	100%
100%	97%
100%	82%
90%	90%
100%	100%
100%	92%
100%	100%
100%	100%
100%	100%
100%	100%
100%	98%
100%	100%
100%	94%
100%	80%
100%	97%
100%	94%
100%	88%
100%	100%
100%	96%
100%	89%
100%	89%
100%	100%
100%	100%
100%	100%
100%	94%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	68%

DEPTH IN FT.	NOTE
0.0	(1)
2.8	(2)
9.1	(3)
10.0	(4)
14.0	(5)
16.2	(6)
16.6	(7)
17.5	(8)
20.0	(9)
24.9	(10)
30.0	(11)
31.4	(12)
31.8	(13)
32.5	(14)
32.6	(15)
35.0	(16)
37.3	(17)
39.0	(18)
40.2	(19)
41.6	(20)
43.5	(21)
45.3	(22)
47.0	(23)
50.4	(24)
50.5	(25)
53.7	(26)
59.2	(27)
62.2	(28)
63.0	(29)
70.2	(30)
70.8	(31)
75.0	(32)
75.4	(33)
75.7	(34)
78.2	(35)
78.6	(36)
80.0	(37)
81.5	(38)
82.6	(39)
83.7	(40)
84.6	(41)
86.7	(42)
87.5	(43)
89.9	(44)
93.8	(45)
96.3	(46)
97.7	(47)
97.7	(48)
100.0	(49)
100.6	(50)
103.4	(51)
103.9	(52)
104.1	(53)
104.4	(54)
106.9	(55)
107.3	(56)
107.8	(57)
116.6	(58)
119.8	(59)
119.8	(60)
119.8	(61)
129.0	(62)
129.6	(63)
133.3	(64)
140.2	(65)
143.1	(66)
143.3	(67)
143.3	(68)
150.5	(69)
151.7	(70)
153.5	(71)
156.7	(72)
157.0	(73)
157.1	(74)
157.3	(75)
159.1	(76)
159.8	(77)

(1) No sample retained. Siltstone as described at 2.8'.
(2) SILTSTONE; moderate brown (5YR 4/4) with dusty red (5YR 3/4) and light gray (N7); mottling; moderately soft with slightly harder calcareous nodules. Abundant light gray calcareous veinlets.
(3) Fracture at 60° from core axis. partly coated with clay and cement.
(4) SILTSTONE; moderate brown (5YR 4/4) with dusty red (5YR 3/4) and light gray (N7); mottling; moderately soft with slightly harder calcareous nodules. Abundant light gray calcareous veinlets.
(5) Fracture at 70° may be mechanical. No clay or cement.
(6) 1" cement seam at 70° from core axis.
(7) Fracture at 60° from core axis. Is iron stained. No evidence of cement.
(8) 1/8" fractured zone contains cement chips.
(9) SILTSTONE; moderate brown (5YR 4/4) with dusty red (5YR 3/4) and light gray (N7); mottling; moderately soft with slightly harder calcareous nodules. Abundant light gray calcareous veinlets.
(10) CLAYSTONE, dark gray (N2) with rededish and gray mottling, with gradational zones of siltstone as above, moderately soft to soft. Clayey zones may result from alteration of siltstone.
(11) CLAYSTONE & SILTSTONE, with gradationally zoned as above.
(12) Fracture at 40° from core axis, slightly polished. Probaly mechanically broken along calcite and iron healed shear. No evidence of cement.
(13) 31.8' to 32.5' very soft.
(14) Iron staining on fracture partly ground by drill. No evidence of cement.
(15) 32.6' to 33.7' numerous 1" - 2" nodules.
(16) Grades to dusky red (5YR 3/4) with gray mottling.
(17) Iron staining and soft clayey coating on fracture. No evidence of cement.
(18) Fracture along iron and calcite healed fracture.
(19) 39.4' contact CLAYSTONE; moderately brown (5YR 3/4) to medium dark gray (N4); moderately soft to moderately hard; contains abundant light grey (N7) calcareous nodules to 0.1' diameter; slightly to moderately weathered.
(20) Irregular, iron.
(21) As at 39.4, CLAYSTONE; moderately brown (5YR 3/4); contains irregular shaped veins of medium gray (N5) calcareous claystone up to 0.1' wide. Few scattered calcareous nodules to 1/2" diameter.
(22) As at 39.4, CLAYSTONE; calcareous nodules, light gray (N7) to 0.15' diameter. Contains medium gray (N5) calcareous claystone veins to 1/2" diameter.
(23) As at 39.4, CLAYSTONE; moderately brown (5YR 3/4), moderately soft to moderately hard; abundant moderately hard to hard calcareous nodules to 0.1' diameter; unfractured.
(24) Good calcite crystals, iron, irregular.
(25) SILTSTONE; gradational contact; moderately brown (5YR 3/4); moderately soft to moderately hard; quartzose; scattered pale olive (10YR 6/2) calcareous nodules to 1" diameter; strong reaction with HCl.
(26) SANDY SILTSTONE; gradational contact; as at 50.5 except moderately brown (5YR 3/4) to dark yellow brown (10YR 4/2); very fine sand grains; quartzone.
(27) Irregular, iron, calcite.
(28) CLAYSTONE; moderately brown (5YR 3/4); moderately soft; clayey; strong reaction with HCl.
(29) SANDSTONE; pale yellow brown (10YR 6/2) to dark yellow brown (10yr 4/2); very fine to fine ground; moderately hard to hard; Quartzose; strong reaction with HCl. bedding dipping at 25° from core axis. no apparent bedding joints.
(30) Iron, planar.
(31) Irregular, iron.
(32) Calcite crystals, iron, irregular.
(33) 75.4–75.7 SANDY SILTSTONE; moderately brown (5YR 3/4); very fine grained; moderately hard, Quartzose; slight to moderate reaction with HCl.
(34) 75.7 SANDSTONE as at 63.0.
(35) Iron, irregular.
(36) SANDSTONE; interbedded moderately brown (5YR 3/4); very fine grained; soft to moderately soft; Quartzose sandstone with pale brown (5YR 5/2); very fine grained; medium hard to hard; Quartzose sandstone; moderate to strong reaction with HCl; bedding dips at 40° from core axis.
(37) Strong reaction with HCl; bedding dips at 40° from core axis.
(38) SANDSTONE; brownish gray (5YR 4/1); very fine grained; hard; Quartzose; calcareous; no bedding plane joints, bedding dips at 40° from core axis, gradational contact.
(39) Grout 3/4" thick.
(40) SILTSTONE; moderately brown (5YR 3/4); very fine grained; moderately hard; Quartzose; scattered olive gray (5YR 4/1); calcareous nodules up to 1/2" diameter. No apparent bedding, strong reaction with HCl; sharp contact.
(41) CLAYSTONE; moderately brown (5YR 3/4); moderately soft; strong reaction with HCl. gradational contact.
(42) Calcareous nodules, olive gray (5YR 4/1); up to 1" diameter.
(43) SANDY SILTSTONE; moderately brown (5YR 3/4); very fine grained; moderately soft to moderately hard; Quartzose; no apparent bedding, no reaction with Hcl., gradational contact.
(44) Scattered calcareous nodules up to 1" diameter from 89.9 to 93.8.
(45) SILTSTONE; moderately brown (5YR 3/4); very fine grained; moderately hard; Quartzose; abundant, olive gray (5YR 5/2); calcareous nodules up to 1/2" diameter. No apparent bedding; strong reaction with HCl; gradational contact.
(46) Calcite, iron coatings.
(47) SANDSTONE; brownish gray (5YR 4/1); very fine to fine grained; hard; Quartzose, calcareous; no apparent bedding; gradational contact.
(48) Grout 1/4" thick, iron, irregular joint.
(49) SILTSTONE; as at 93.8. Contact within core loss zone.
(50) Iron, irregular.
(51) Some calcite (possibly healed fracture) appears to be mechanical.
(52) Calcite, iron, irregular.
(53) Irregular, calcite, iron, some clay.
(54) Irregular, calcite, iron, some clay on fracture.
(55) SILTSTONE; as at 100.0 except grayish brown (5YR 3/2); medium hard to hard; calcareous; no calcareous nodules.
(56) Calcite, partly healed fracture.
(57) CLAYSTONE; mottled moderately brown (5YR 3/4); grayish green (10GY 5/2) and light olive brown (5YR 5/6); moderately hand; Clayey, contains some silt; calcareous scattered light gray (N7) to grayish yellow (5G 7/2); calcareous nodules; no apparent bedding.
(58) SANDY SILTSTONE; mottled moderately brown (5YR 3/4); grayish green (10GY 5/2) and light olive brown (5YR 5/6); very fine grained; moderately hard; Quartzose, calcareous scattered light gray (N7) calcareous nodules up to 1/4" diameter; no apparent bedding. Gradational contact.
(59) SANDSTONE; grayish brown (5YR 3/2); to moderate brown (5YR 3/4); very fine to fine grained; moderately hard to hard; Quartzose, calcareous; no apparent bedding; gradational contact.
(60) SILTSTONE; mottled moderate brown (5YR 3/4); dark reddish brown (10R 3/4) and dusky yellow green (5GY 5/2); moderately soft to moderately hard; very fined grained; Quartzose, calcareous; no apparent bedding; gradational contact.
(61) CLAYSTONE; mottled moderate brown (5YR 3/4); dark reddish brown (10R 3/4) and dusky yellow green (5GY 5/2); moderately soft to moderately hard; clayey, calcareous; no apparent bedding; gradational contact.
(62) Grout, calcite, clay planar.
(63) CLAYSTONE; as at 126.5 except olive gray (5YR 3/2); dark reddish brown (10R 3/4) and dusky yellow green (5GY 5/2); contains scattered calcareous nodules up to 1/4" diameter.
(64) CLAYSTONE; as at 126.5 except scattered pale red (10R 6/2); and duskey yellow (5GY 5/2), moderately hard. Calcareous nodules up to 1" diameter.
(65) SILTSTONE; moderate brown (5YR 3/4); moderately soft; Quartzose, silt size material; core has scattered calcareous nodules up to 1" diameter, gradational contact.
(66) Iron healed.
(67) Partially healed with iron oxide, irregular.
(68) CLAYSTONE; moderate brown (5YR 3/4); moderately soft to moderately hard; clayey, contains numerous calcareous nodules up to 1/2" diameter from 144.3 to 146.6; gradational contact.
(69) SANDSTONE; moderate brown (5YR 3/4); very fine grained; moderately hard; Quartzose, calcareous; nodules throughout. maximum size 1/4" diameter; gradational contact.
(70) Iron stained, some clay.
(71) Partly healed 1/8" thick.
(72) Some iron staining.
(73) Some iron staining.
(74) Slickensides.
(75) Some iron staining.
(76) SANDSTONE; as at 150.5 except brownish gray (5YR 4/1); more calcareous matrix; sharp contact.
(77) SANDSTONE; as at 150.5 no calcareous nodules.

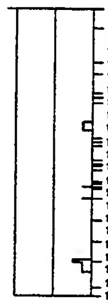
1F-102 (CONT'D.)

RECOVERY %		N887,596	E1,943,831
WATER	CORE	ELEV.	DEPTH IN FT.

100 0 100

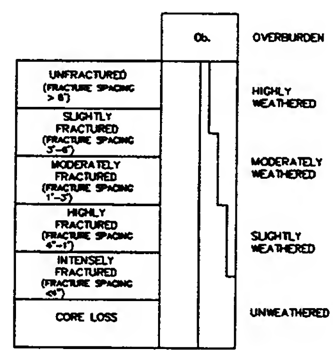
5436.0

WATER	CORE
100%	100%
100%	100%
100%	100%
100%	100%
100%	94%
100%	100%
100%	96%

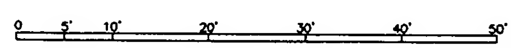


162.0	(78)
165.6	(79)
166.8	(80)
168.8	(81)
169.2	(82)
169.3	(83)
169.8	(84)
173.5	(85)
173.9	(86)
174.3	(87)
175.8	(88)
176.2	(89)
176.4	(90)
176.8	(91)
178.0	(92)
178.3	(93)
178.6	(94)
178.8	(95)
179.8	(96)
182.1	(97)
184.3	(98)
186.4	(99)
189.1	(100)
190.0	(101)

(78) SANDSTONE; as at 150.5 except dusky brown (5YR 2/2); very few calcareous nodules; gradational contact.
(79) SANDSTONE; brownish gray (5YR 4/1); fine grained; moderately hard to hard; Quartzose, calcareous; bedding dips at 40° from core axis. No apparent bedding plane joints; gradational contact.
(80) Iron stained.
(81) Iron stained.
(82) Calcite and iron coatings.
(83) SANDSTONE; moderate brown (5YR 4/3); moderately hard, very fine grained.
(84) SANDSTONE; olive gray (5YR 4/1); very fine to fine grained; Quartzose, slight to moderate reaction with HCl.; moderately soft to moderately hard; no appartent bedding or bedding plane joints; gradational contact
(85) SANDSTONE; light olive gray (5YR 5/1); very fine to fine grained; Quartzose, calcareous, gradational contact, core ranges from massive to faint bedding.
(86) Iron coated.
(87) Iron coated, possibly iron healed, fracture appears fresh.
(88) Iron and calcite.
(89) Mottled light olive gray to dark yellow brown (10YR 4/2).
(90) Organic material dusky yellow brown (10YR 2/2); soft.
(91) Clay gouge 0.1' thich slickensided at 70° from core axis. Organic material.
(92) 178.0 to 178.2 organic material as at 176.4.
(93) Partialy healed with iron.
(94) 178.6 to 179.8 SANDSTONE; as at 173.5 except considerable iron oxide staining present.
(95) Iron, 1/2" of grout.
(96) SANDSTONE; light olive gray (5Y 6/1); fine grained; hard; Quartzose, calcareous; massive to very very faint bedding at 45° from core axis.
(97) Iron stained.
(98) Iron stained.
(99) Iron stained.
(100) SANDSTONE; as at 174.8 except thin bedded with grayish black N2, soft organic material on bedding planes; laminated to 1/2" apart; some pyrite on bedding.
(101) Bottom of hole.



GRAPHIC SCALE:



(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION EXPLORATION
LOG OF CORED DRILL HOLE
1F-102

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED:	APPROVED:
for CARL E. COLE, RESIDENT GEOLOGIST	PAUL M. PARSONEAULT, RESIDENT ENGINEER

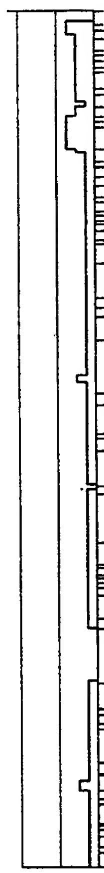
ERE		BAB	PLATE 109

1F–103 INCLINED 60° AT N39°W

RECOVERY %		N887,686	E1,943,738
WATER	CORE	ELEV.	DEPTH IN FT.

100 0 100 5613.0

WATER	CORE
100%	74%
100%	83%
100%	64%
100%	100%
100%	100%
100%	50%
100%	86%
100%	100%
100%	100%
100%	98%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	98%



DEPTH IN FT.	
1.1	(1)
1.5	(2)
2.1	(3)
3.0	(4)
4.2	(5)
4.7	(6)
5.3	(7)
6.0	(8)
6.5	(9)
8.2	(10)
8.8	(11)
10.1	(12)
11.1	(13)
11.6	(14)
12.2	(15)
14.5	(16)
15.8	(17)
16.3	(18)
16.4	(19)
17.4	(20)
18.3	(21)
19.5	(22)
20.0	(23)
21.0	(24)
21.4	(25)
22.0	(26)
22.3	(27)
23.0	(28)
24.0	(29)
24.4	(30)
26.4	(31)
30.0	(32)
31.0	(33)
32.0	(34)
34.4	(35)
34.4	(36)
40.0	(37)
41.2	(38)
42.3	(39)
44.7	(40)
46.0	(41)
49.7	(42)
50.5	(43)
55.6	(44)
57.9	(45)
58.2	(46)
59.0	(47)
59.3	(48)
59.8	(49)
60.3	(50)
61.1	(51)
63.5	(52)
64.6	(53)
70.3	(54)
72.9	(55)
73.0	(56)
73.6	(57)
74.5	(58)
75.1	(59)
78.6	(60)
79.8	(61)
79.9	(62)
81.5	(63)
82.4	(64)
82.9	(65)
83.0	(66)
85.0	(67)
85.3	(68)
85.6	(69)
86.3	(70)
87.4	(71)
87.9	(72)
89.5	(73)

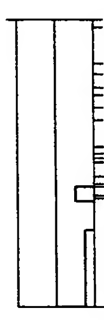
(1) SANDSTONE; light brown (5YR 5/6) where weathered intensely to light olive gray (5Y 6/1); very fine grained; soft were weathered to hard; Quartzose; moderately to intensely weathered.
(2) Iron healed.
(3) Iron, clay, rock chips.
(4) Calcite healed.
(5) Grout, iron, clay, planar joint.
(6) SANDSTONE; as at 1.1".
(7) 1/8" clay, irregular, specks of grout.
(8) Iron, clay grout specks.
(9) Bedding plane, iron stained.
(10) Clay, planar joint.
(11) SANDSTONE; is fine grained.
(12) SANDSTONE; as at 8.8'.
(13) CLAYSTONE, yellow gray (5Y 5/2) to light olive brown (5Y 5/6); very soft.
(14) Clay seam or gouge.
(15) 12.2–12.5 clay seam, dark yellow brown (10YR 4/2).
(16) SILTSTONE; light olive gray (5Y 6/1); moderate soft to moderate hard; some calcareous nodules present.
(17) Iron, partially healed.
(18) Iron, calcite, clay.
(19) Calcareous sandstone; very fine grained; moderate soft to moderate hard, scattered calcareous nodules to 1/2" diameter.
(20) Calcite healed joint.
(21) Calcite, MNO.
(22) Clay seam or gouge.
(23) SANDSTONE; as at 16.4 olive gray (5Y 4/1).
(24) Calcite, iron.
(25) Calcite, iron.
(26) Calcite, iron.
(27) Open, Calcite, iron, calcite crystals.
(28) Partially open Calcite healed.
(29) Gradational contact SILTSTONE; dark reddish brown (10R 3/4); moderate soft to moderate hard; calcareous nodules to 1/4" diameter.
(30) Gradational contact CLAYSTONE; dark reddish brown (10R 3/4); from 24.4–24.7 and mottled light olive gray (5Y 5/2) to very light gray N8; 24.7–25.2 moderate soft to moderate hard; clayey. contains calcareous nodules (N9) to 1" diameter.
(31) SILTY CLAYSTONE; olive gray (5Y 4/1); very soft to soft; clayey with some silt.
(32) SILTY CLAYSTONE; as at 26.4.
(33) Shear zone, clay gouge, breccia 30° from core axis.
(34) SANDY SILTSTONE; dark yellow brown (10YR 4/2) very soft; composed of silt with very fine, quartzose sand.
(35) Gradational contact.
(36) SANDY SILTSTONE; dark reddish brown (10YR 3/4); very soft to soft; composed of silt and very fine sand, Quartzose; calcareous nodules scattered throughout to 1/2" diameter.
(37) SANDY SILTSTONE; as at 34.4 except very soft to soft; at 39.7 grades to light olive gray (5Y 6/1).
(38) Iron, clay.
(39) SANDSTONE; mottled dark reddish brown (10R 3/4); and pale red (5R /2); calcareous, very fine grained; Quartzose; where pale red – calcareous sandstone;gradational contact.
(40) SANDSTONE; as at 42.3.
(41) Grout, partially healed.
(42) Calcite, iron, open joint, good calcite crystals.
(43) SANDSTONE; as at 42.3 except no calcareous sandstone – below 50.5.
(44) Gradational contact calcareous SANDSTONE; grayish red (10R 4/2); very fine grained; moderate hard to hard; slightly weathered.
(45) Grout.
(46) Iron stained.
(47) Iron,irregular, grout.
(48) Grout, iron, calcite.
(49) Grout, iron stained.
(50) Gradational contact, SANDY SILTSTONE; modertate reddish brown (10R 4/6); moderate hard; silt with very fine sand.
(51) Gradational contact, calcareous sandstone as at 55.6.
(52) Contact, calcareous sandstone as at 55.6 except some calcareous nodules to 1" diameter.
(53) As at 63.5, except no nodules.
(54) As at 63.5, calcareous sandstone, grayish red.
(55) Gradational contact.
(56) SANDY SILTSTONE; mottled grayish red (10R 4/2); to pale red (10R 6/2); moderate hard; silt with very fine sand.
(57) Gradational contact.
(58) Calcareous sandstone as at 63.5.
(59) Gradational contact, interbedded sandstone and calcareous sandstone; calcareous sandstone is grayish red (10YR 4/2); sandstone is moderate brown (10YR 4/2); moderately hard to hard; very fine sand, quartzose; considerable calcareous matrix where calcareous sandstone.
(60) Grout at 78.6 and 79.3.
(61) Gradational contact, SANDSTONE; olive gray (5Y 4/1); very fine to fine grained; hard; Quartzose;. slightly weathered.
(62) Grout, iron.
(63) Iron, grout at 81.5, 81.8, and 82.0.
(64) Grout.
(65) Grout, iron, calcite.
(66) Grout at 83.0 and 84.5.
(67) Iron, grout 1/4" wide.
(68) As at 79.8.
(69) Iron.
(70) 86.3–86.6 as at 79.8 except fine to medium grained sandstone.
(71) Iron.
(72) Iron, healed.
(73) Bottom of hole.

1F–104 VERTICAL

RECOVERY %		N887,127	E1,944,216
WATER	CORE	ELEV.	DEPTH IN FT.

100 0 100 5630.0

WATER	CORE
100%	67%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%



DEPTH IN FT.	
0.0	(1)
0.8	(2)
4.6	(3)
5.7	(4)
7.1	(5)
8.9	(6)
9.2	(7)
10.5	(8)
13.3	(9)
14.0	(10)
14.5	(11)
14.9	(12)
16.4	(13)
17.5	(14)
18.4	(15)
18.7	(16)
20.0	(17)
21.4	(18)
22.8	(19)
23.3	(20)
23.9	(21)
25.4	(22)
26.8	(23)
27.0	(24)
29.5	(25)

(1) Not sampled – drilled with percussion drill to install surface casing.
(2) CONGLOMERATE; matrix varies from dark gray (N3) to dark yellow brown (10YR 4/2), rounded clasts to 0.8 ft. are mostly shades of gray from lt gray (N7) to dark gray (N3), matrix is fine grained, subangular subrounded cemented sand, matrix and clasts are mostly hard to very hard except where softened by weathering; faint bedding apparent at 30° to 35° from core axis between 4.6 and 7.0' deep. Matrix and clasts are generally calcareous. Most fractures moderate to highly weathered and stained with brown, orange & black iron deposits with some manganese dendrites; core losses occur in intensely fractured zones where weathering has softened the rock.
(3) CONGLOMERATE; medium light gray (N6) to light grey (N7). Clasts very hard, matrix hard clasts from cobble to .5" diameter, very hard, light gray. Matrix gray, hard.
(4) SANDSTONE; medium light gray (N6), very hard, thin veins of calcite.
(5) CONGLOMERATE; medium light gray (N6) to light grey (N7).
(6) Broken, weathered joint, some grout.
(7) CONGLOMERATE; as of 9.2.
(8) Weathered, open joint, stained light brown, grout traces.
(9) CONGLOMERATE; as above.
(10) Slight weathering. traces of dark brown staining.
(11) Open joint, light brown staining. grout in fractures.
(12) CONGLOMERATE; as of 14.9 above. Top of run broken.
(13) Some weathering in joint.
(14) CONGLOMERATE; as above as of 17.5 , heavily jointed and broken up where matrix eroded.
(15) Joint weathered and stained brown.
(16) Weathered stained.
(17) CONGLOMERATE; as above.
(18) CONGLOMERATE; as above as of 21.4.
(19) Joint weathered and stained brown.
(20) Calcite along joint surface.
(21) CONGLOMERATE; as above as of 23.9.
(22) Weathered, very fractured, some brown staining, matrix washing.
(23) Cement in fracture .07" thick.

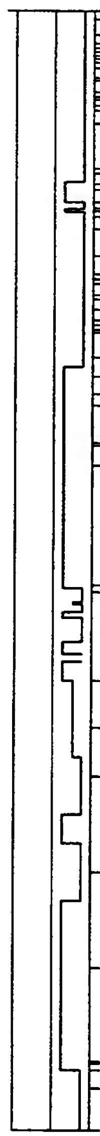
1F-104 (CONT'D.)

RECOVERY %		ELEV.	DEPTH IN FT.
WATER	CORE	N887,127	E1,944,216

100 0 100

5600.0

WATER	CORE
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	100%
100%	82%
100%	92%
100%	100%
	100%
	100%
	83%
	100%
	100%
	100%
	78%
	100%
	74%
	100%
	100%
	100%
	100%
	[illegible]
	55%
	93%
	91%
	53%
	66%
	70%
	67%
	29%
	72%



DEPTH IN FT.	
27.0	(24)
29.5	(25)
30.0	(26)
30.9	(27)
32.5	(28)
33.4	(29)
33.9	(30)
34.3	(31)
34.7	(32)
35.0	(33)
35.4	(34)
35.6	(35)
36.0	(36)
37.0	(37)
37.3	(38)
38.5	(39)
39.0	(40)
39.9	(41)
40.4	(42)
41.8	(43)
46.5	(44)
47.0	(45)
48.1	(46)
48.5	(47)
50.6	(48)
50.9	(49)
51.5	(50)
52.8	(51)
55.6	(52)
57.5	(53)
58.0	(54)
58.1	(55)
58.5	(56)
58.7	(57)
60.1	(58)
60.7	(59)
61.2	(60)
62.3	(61)
62.8	(62)
63.3	(63)
63.6	(64)
66.2	(65)
68.2	(66)
71.2	(67)
75.1	(68)
75.4	(69)
77.5	(70)
90.0	(71)
90.7	(72)
100.0	(73)
104.9	(74)
110.0	(75)
120.0	(76)
130.0	(77)
139.8	(78)
140.0	(79)
140.7	(80)
142.6	(81)
147.0	(82)

(24) CONGLOMERATE: as above as of 27.0.
(25) CONGLOMERATE: as above as of 27.0.
(26) Fractured, no staining, some cement on bottom surface.
(27) CONGLOMERATE: as above as of 30.9.
(28) CONGLOMERATE: as above as of 32.5.
(29) Grout trace on bottom fracture surface.
(30) Some staining yellow to brown, weathered.
(31) Yellow staining, open, weathered.
(32) Broken, no staining, matrix washing.
(33) Broken, washed, yellow to brown stain.
(34) CONGLOMERATE: as above as of 32.4.
(35) Fracture with trace grout.
(36) Vertical fracture weathered stain yellow to brown. Thick seam of grout 0.08', along vertical fracture surface, fracture weathered , stained yellow to brown.
(37) Weathered, stained yellow to brown.
(38) CONGLOMERATE: as above as of 37.3.
(39) Broken, washed, stained light brown, grout traces.
(40) Washed, stained light brown, grout traces. Thick seam of grout 0.075'.
(41) CONGLOMERATE: as above as of 39.9.
(42) Stained yellow to light brown, grout traces.
(43) CONGLOMERATE: as above as of 41.8.
(44) CONGLOMERATE: as above as of 46.5.
(45) Calcite, brown staining.
(46) Weathered, light brown staining.
(47) Washed out matrix, light brown to black staining.
(48) CLAYSTONE: light olive gray(5Y 6/1); very soft black to orange stain.
(49) SILTY SANDSTONE: grayish brown (5YR 3/2); with light brownish gray mottling (5YR 6/1), fine grained, moderate hard, calcareous, light iron staining on fractures.
(50) SILTY SANDSTONE: as above, broken, weathered moderately.
(51) Slightly weathered sandstone, grading to mottled with grayish brown (5YR 3/2), and very light gray (N8).
(52) Slightly weathered with some dusky red (5R 3/2), mottling to end of run.
(53) Angled fracture moderately weathered, yellow and brown staining.
(54) Vertical fracture as above.
(55) Vertical fracture moderately weathered, yellow, brown and black stain.
(56) Vertical fracture as above, grout in horizontal fracture.
(57) Rock becomes more weathered, moderately soft.
(58) CLAYEY SANDSTONE: moderate olive brown (5YR 4/4); mottled very light gray (N8), moderately hard.
(59) Vertical and horizontal fractures moderately weathered.
(60) CLAYEY SANDSTONE: moderate olive brown (5YR 4/4); mottled with very light gray (N8); moderately hard, moderately weathered.
(61) SANDY SILTSTONE: dark yellowish brown (10YR 4/2); very fine grained, moderately soft, slakes slightly to moderately after 7 months.
(62) Rock as above with some washing and solutioning, open small vugs in core.
(63) Washed, highly weathered.
(64) CLAYSTONE: dark yellowish brown (10YR 4/2); soft; moderate to severely weathered, severely weathered as of 63.9.
(65) CLAYSTONE: as above; very soft.
(66) CONGLOMERATE: significate core losses in highly fractured, softened zones.
(67) CONGLOMERATE: as above, hightly washed and recovered with no matrix.
(68) Core loss to 75.4.
(69) CONGLOMERATE: as above, severely washed.
(70) CONGLOMERATE: as above, severely washed.
(71) CONGLOMERATE: as above, hard to very hard except where core lost.
(72) Fractures generally weathered and iron stained. Many fractures break around rounded clasts.
(73) CONGLOMERATE: as above, mostly hard to very hard except where core lost.

(74) SILTSTONE: grades back to hard sandstone matrix of conglomerate; pale yellowish brown (10YR 6/2); very fine grained (aphanitic) moderately soft grades to moderately hard; 104.9 t0 105.6 slaked moderately after 7 months in closed core box.

(75) CONGLOMERATE: as above, recovered fragments are generally hard to very hard with softening evident at edges of some fragments. Fragments generally iron stained.

(76) CONGLOMERATE: as above, slightly to highly weathered.

(77) CONGLOMERATE: as above, weathering highly variable.

(78) Very soft to hard, altered clayey seams.
(79) CONGLOMERATE: as above, very soft to hard.
(80) SANDSTONE: dark yellowish brown (10YR 4/2); fine grained, moderately soft to moderately hard; iron staining on fractures, calcareous.
(81) CONGLOMERATE: as above at 139.8.

(82) Bottom of hole.

GRAPHIC SCALE:

0 5' 10' 20' 30' 40' 50'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION EXPLORATION

LOGS OF CORED DRILL HOLES
1F-103 AND 1F-104

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Tract for CARL E. COLE, RESIDENT GEOLOGIST			APPROVED: [signature] PAUL M. PARSONEAULT, RESIDENT ENGINEER
DR. BY: ERE	CK. BY:	GEOL. BY: BAB	FILE NO.: PLATE 110

1F-105 VERTICAL

RECOVERY %				
WATER	CORE	N886,881 ELEV.	E1,944,396	DEPTH IN FT.

100 0 100

5838.5

100%
88%
80%
100%
96%
100%
100%
100%
97%
82%
84%
93%
100%
86%
93%
86%
100%
100%
100%
100%
100%
97%
98%
95%
98%
98%
100%
98%
100%
100%

0.0	(1)	(1)	Overburden – drilled with tri-cone bit, not sampled.
10.4	(2)	(2)	<u>SANDSTONE</u>; brownish gray; fine grained; moderate to hard. Iron and manganese staining on most fractures.
11.7	(3)	(3)	Fracture coated with iron and manganese oxide.
12.7	(4)	(4)	Fracture coated with iron and manganese oxide and calcite
13.3	(5)	(5)	<u>SANDSTONE</u>; soft to moderately hard.
16.1	(6)	(6)	Moderately hard.
17.6	(7)	(7)	<u>SANDSTONE</u>; light brown; very soft.
20.6	(8)	(8)	Soft.
23.0	(9)	(9)	<u>SANDSTONE</u>; light gray, moderately hard.
24.0	(10)	(10)	Some fractures are covered with soft, wet, red clay.
25.2	(11)	(11)	Hard.
27.5	(12)	(12)	Hard.
35.0	(13)	(13)	<u>SANDSTONE</u>; becomes hard, more solid.
37.3	(14)	(14)	Silty zone is highly fractured and weathered along fractures.
40.0	(15)	(15)	<u>SANDSTONE</u>; as above, machine broken fracture.
43.0	(16)	(16)	<u>SANDSTONE</u>; light brownish gray; moderately hard.
47.7	(17)	(17)	<u>SANDSTONE</u>; light gray; hard.
49.1	(18)	(18)	<u>SANDSTONE</u>; brown; soft.
50.5	(19)	(19)	<u>SANDSTONE</u>; as above.
52.2	(20)	(20)	<u>SANDSTONE</u>; as above.
56.2	(21)	(21)	Weathering highly variable, slightly to highly, some very soft zones.
60.4	(22)	(22)	<u>SANDSTONE</u>; medium grained, brownish gray; highly fractured with iron oxide staining; clay and calcite coatings on fractures.
63.2	(23)	(23)	Dark red to brown; iron staining in sandstone.
66.5	(24)	(24)	Very soft.
68.5	(25)	(25)	<u>SANDSTONE</u>; coarse grained with some pebbles; light gray; very soft along fractures, grout in some fractures, iron oxide and clay coating on fractures.
70.0	(26)	(26)	<u>SANDSTONE</u>; as above; less weathering along fractures, thicker calcite on fractures.
77.0	(27)	(27)	<u>CONGLOMERATE</u>; light brown to gray; moderate hard to very soft due to variable weathering; grout in some fractures, iron oxide and clay coating on fractures.
80.4	(28)	(28)	80.4 t0 86.4 near vertical fault; .01 to .05' thick seam of clay gouge forms contact between <u>CONGLOMERATE</u> as above and <u>CLAYSTONE</u>; greenish gray; soft to moderately hard; iron and manganese on fractures.
82.3	(29)	(29)	<u>CLAYSTONE</u>; as above.
83.7	(30)	(30)	Iron and manganese; oxide staining throughout claystone.
88.7	(31)	(31)	<u>SILTSTONE</u>; brownish red; soft to very soft.
88.7	(32)	(32)	<u>SILTSTONE</u>; gray with red mottling, moderate hard, manganese oxide common.
105.9	(33)	(33)	<u>SANDSTONE</u>; fine grained; light gray; moderately hard.
107.1	(34)	(34)	<u>SANDSTONE</u>; as above; hard.
108.0	(35)	(35)	Fractures coated with iron oxide and moganese stains and calcite.
111.2	(36)	(36)	Grout in fracture.
113.0	(37)	(37)	Grout in many fractures below this point; varies from powdery discontinous coating to hard .1' filling.
119.1	(38)	(38)	<u>SANDSTONE</u>; light brown; fine grained; soft; fractures coated with iron oxide and manganese oxide.
120.8	(39)	(39)	<u>SANDSTONE</u>; grades to light brownish gray.
129.6	(40)	(40)	<u>SANDSTONE</u>; grades to light gray due to decrease in weathering.
129.6	(41)	(41)	Highly fractured zone has grout on nearly all fractures.
130.5	(42)	(42)	Highly fractured area, iron oxide, stained clay and manganese oxide.
131.7	(43)	(43)	Fractured, slightly stained with iron and manganese oxide.
136.0	(44)	(44)	Iron staining common along bedding at about 70° from long axis of core, grout on some fractures.
139.0	(45)	(45)	Grout on fracture surfaces in highly fractured zone.
143.5	(46)	(46)	0.1' grout seam.
145.2	(47)	(47)	Moderate to highly weathered along fractures.
147.0	(48)	(48)	<u>SANDSTONE</u>; grades to medium grained.
154.6	(49)	(49)	<u>SANDSTONE</u>; brownish gray; coarse grained with few pebbles; very soft.
155.2	(50)	(50)	<u>SANDSTONE</u>; light gray; fine to medium grained; hard; fractures stained with iron and moganese oxide and grout in most fractures.

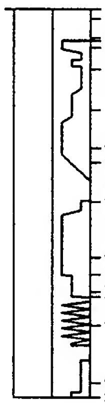
1F-105 (CONT'D.)

RECOVERY %		N886,881	E1,944,396
WATER	CORE	ELEV.	DEPTH IN FT.

100 0 100

5678.5

WATER	CORE
	94%
	98%
	86%
	88%
	72%
	90%
	70%
	100%



161.0	(51)	(51)	Fractures coated with dark reddish brown and orange iron oxide and grout.
163.0	(52)	(52)	Light gray; zone is hard with soft zones in highly weathered areas.
164.0	(53)	(53)	SILTSTONE: light grayish brown; moderate to soft; fractures coated with iron oxide clay.
166.3	(54)	(54)	Grades to medium gray; moderate to soft; fractures coated with iron oxide, manganese oxide; grades to hard; fractures coated with iron and manganese oxide and grout.
170.5	(55)	(55)	SILTSTONE: as above; 170.5 to 176.0 fault zone, highly fractured with soft clayey zones, slickensides at 171.0
174.5	(56)	(56)	SILTSTONE: light to medium brown, highly weathered, very soft.
176.0	(57)	(57)	SANDSTONE: light brown grades to light grayish brown with decreasing weathering; fine grained; soft moderately hard to hard; Quartzose, calcareous; no apparent bedding; gradational contact.
180.1	(58)	(58)	SANDSTONE: as above; fault zone 180.1 to 195.0, highly fractured, weathered and softened, poor core recovery.
		(59)	GOUGE AND BRECCIA: red, tan, and light grayish brown zones, very soft, clayey with hard, angular, gray sandstone fragments.
185.9	(59)	(60)	SANDSTONE: is highly fractured (brecciated) and variably weathered and softened, generally hard to very soft. fractures coated with orange and black iron oxide and some calcite.
187.7	(60)		
189.5	(61)	(61)	Highly fractured, fractures coated with iron oxide.
190.0	(62)	(62)	SANDSTONE: light gray to brown; fine grained, moderately hard; fractures coated with reddish orange iron oxide.
193.0	(63)	(63)	Calcite present in fracture.
199.0	(64)	(64)	Grades to medium gray.
200.5	(65)	(65)	Bottom of hole.

GRAPHIC SCALE:

0 5' 10' 20' 30' 40' 50'

(SCALE IN FEET)

LITTLE DELL LAKE
SALT LAKE CITY STREAMS, UTAH

FOUNDATION EXPLORATION
LOG OF CORED DRILL HOLE
1F-105

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SUBMITTED: Robert L. Tout for CARL E. COLE, RESIDENT GEOLOGIST

APPROVED: PAUL M. PARSONEAULT, RESIDENT ENGINEER

DL BY:	TR BY:	GEOL BY:	FILE No:
ERE		BAB	PLATE 111

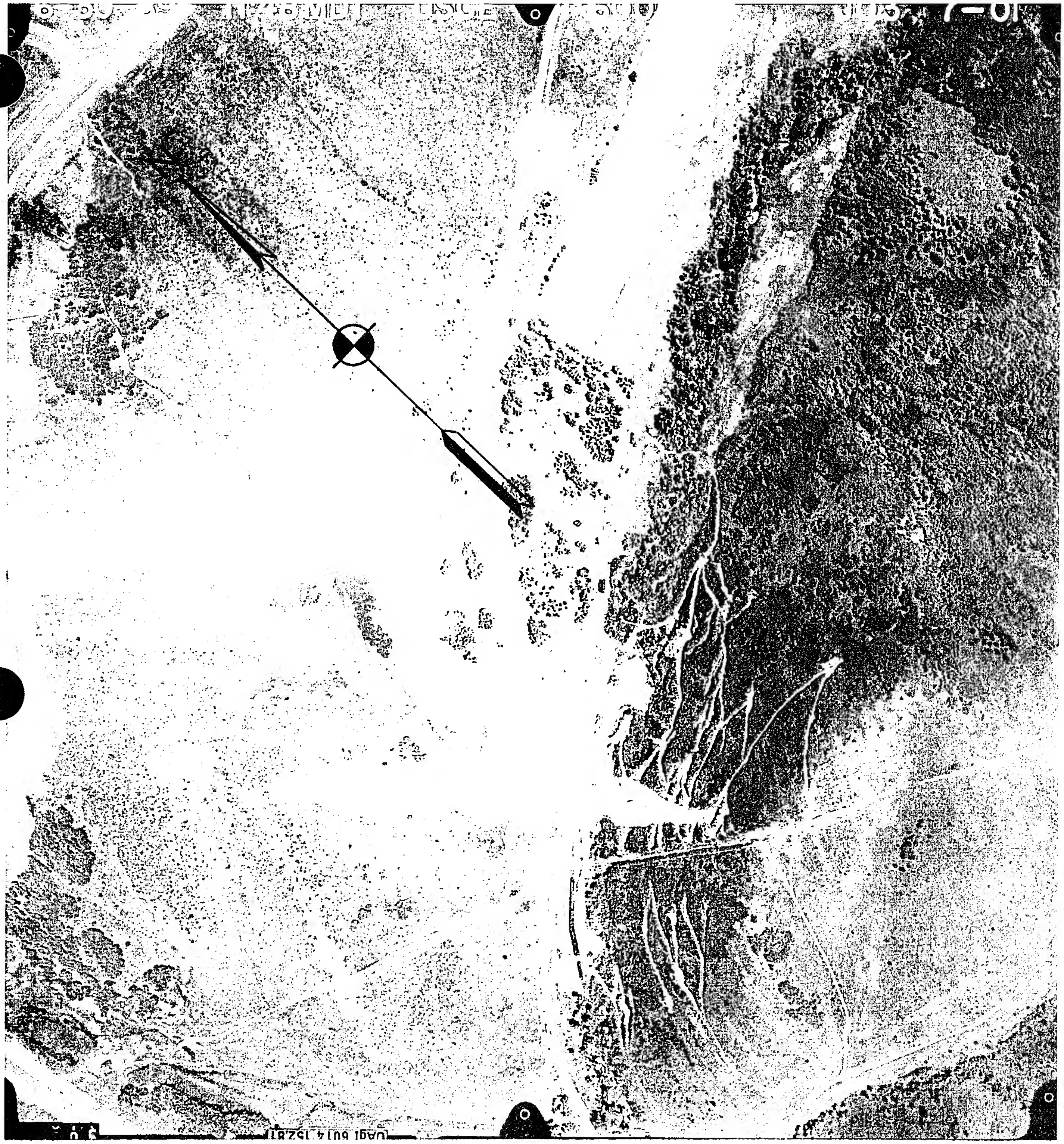


PHOTO 1. AERIAL PHOTO OF DAMSITE ON 6/30/89.

PHOTO 2. AERIAL PHOTO OF DAMSITE ON 11/1/89.

PHOTO 3. AERIAL PHOTO OF DAMSITE ON 5/2/90.

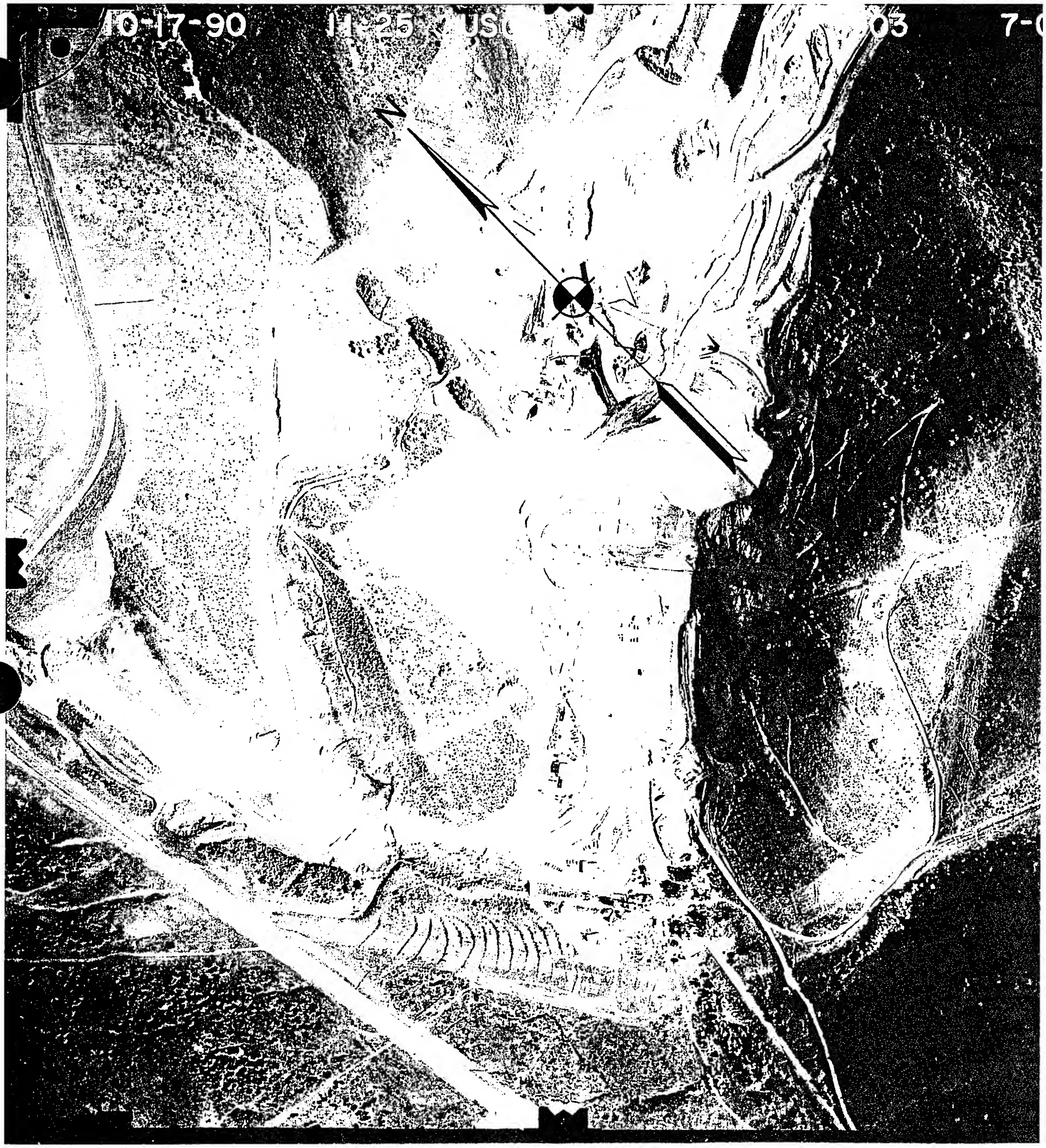


PHOTO 4. AERIAL PHOTO OF DAMSITE ON 10/17/90.

PHOTO 5. AERIAL PHOTO OF DAMSITE ON 05/16/91.

PHOTO 6. AERIAL PHOTO OF DAMSITE ON 11/11/91.

PHOTO 7. AERIAL PHOTO OF DAMSITE ON 05/14/92.

PHOTO 8. AERIAL PHOTO OF DAMSITE ON 11/11/92.

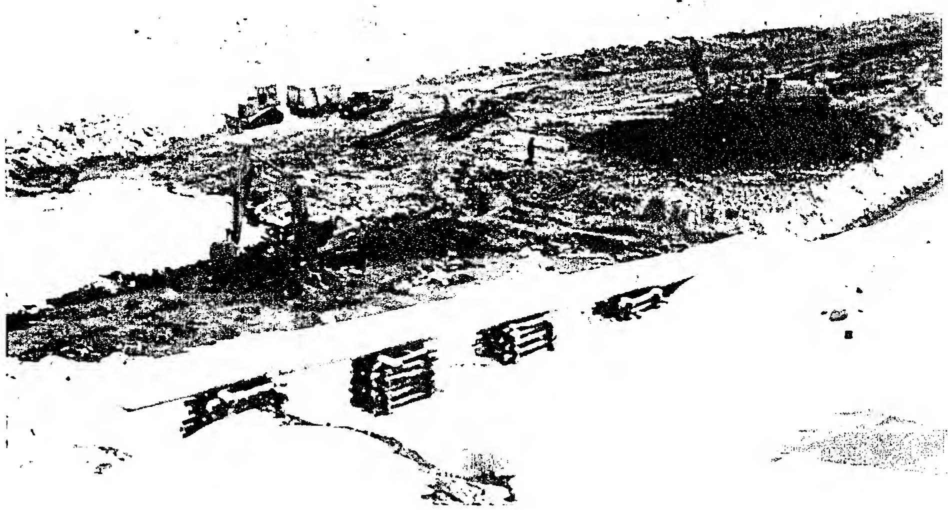


PHOTO CT1 (Core Trench 1). Contractor attempted to perform preliminary cleanup of core trench on this date, 2/14/90, but abandoned the effort. Photo looks south at the orange backhoe near dam axis, Sta. 15+00.

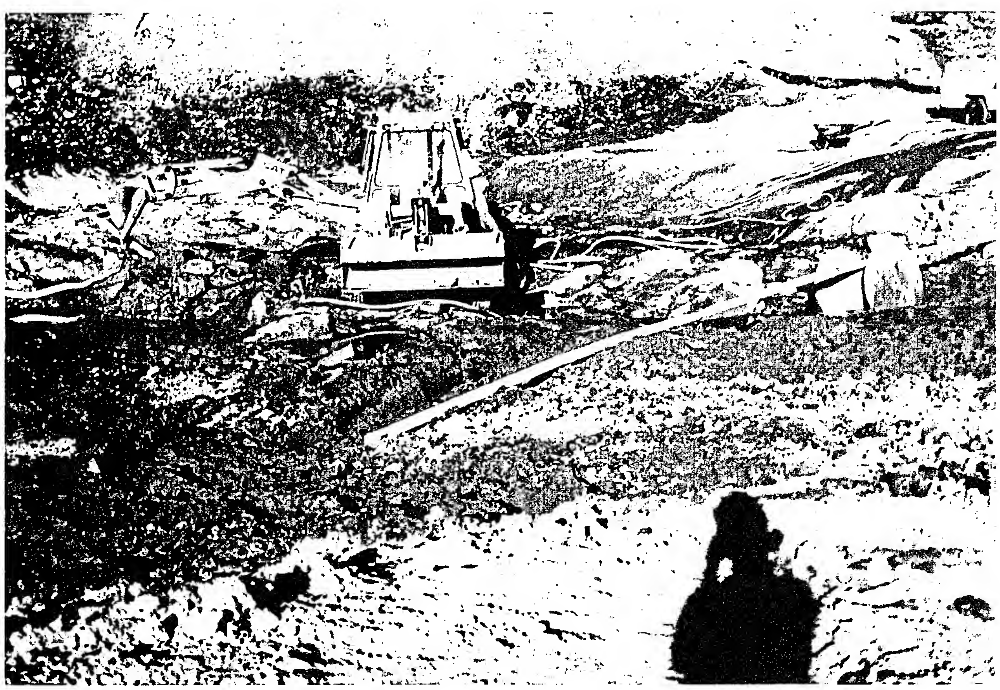


PHOTO CT2. Looking upstream as Contractor works on preliminary cleanup near Sta. 14+20. 3/22/90.

PHOTO CT3. Looking downstream and left at preliminary cleanup at base of left abutment, near Station 14+00

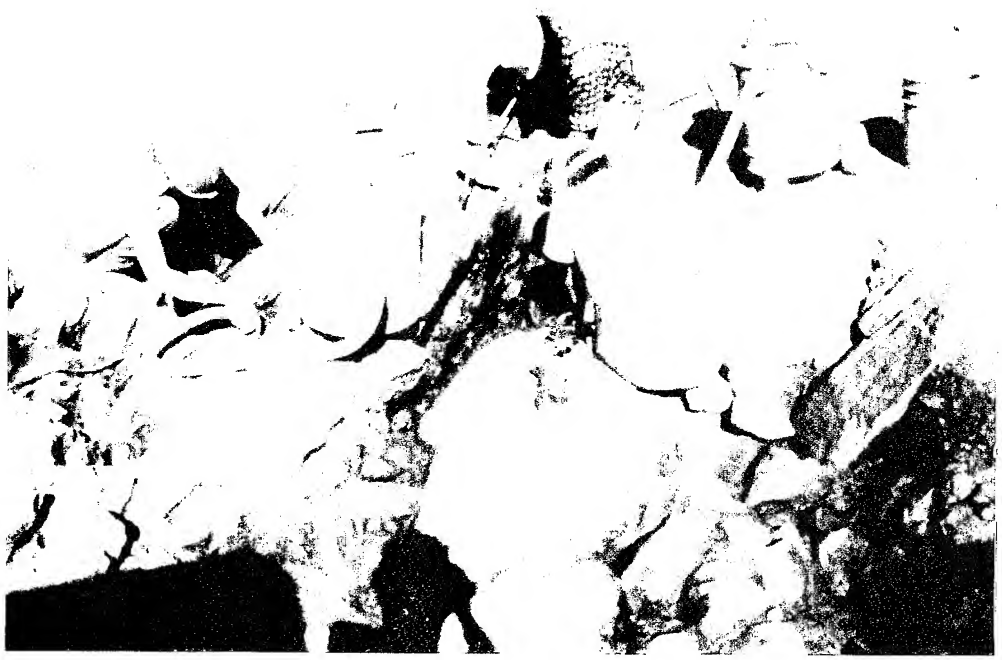


PHOTO CT4. Core trench near Station 15+00. Crew cleaning soft material from fractures before placing mortar and dental concrete.

PHOTO CT5. Looking left near Sta. 15+00 in core trench at joints that have been mortared. The white color resulted from curing compound which was initially applied to the surface of the mortar. This practice was later discontinued.

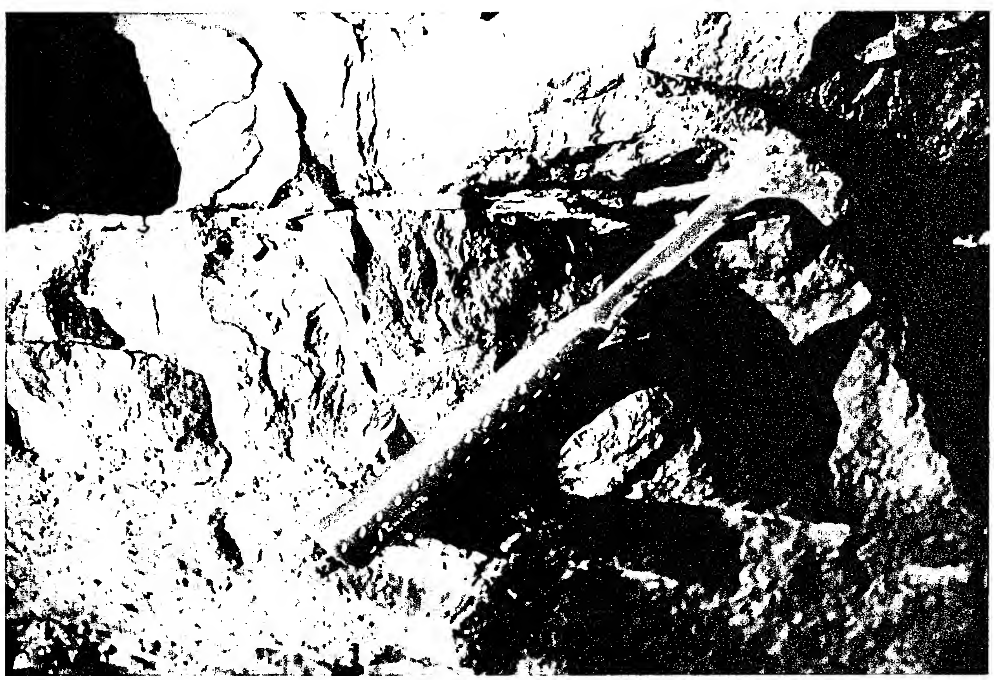


PHOTO CT6. Grout filling in fracture near foundation grout curtain in core trench.

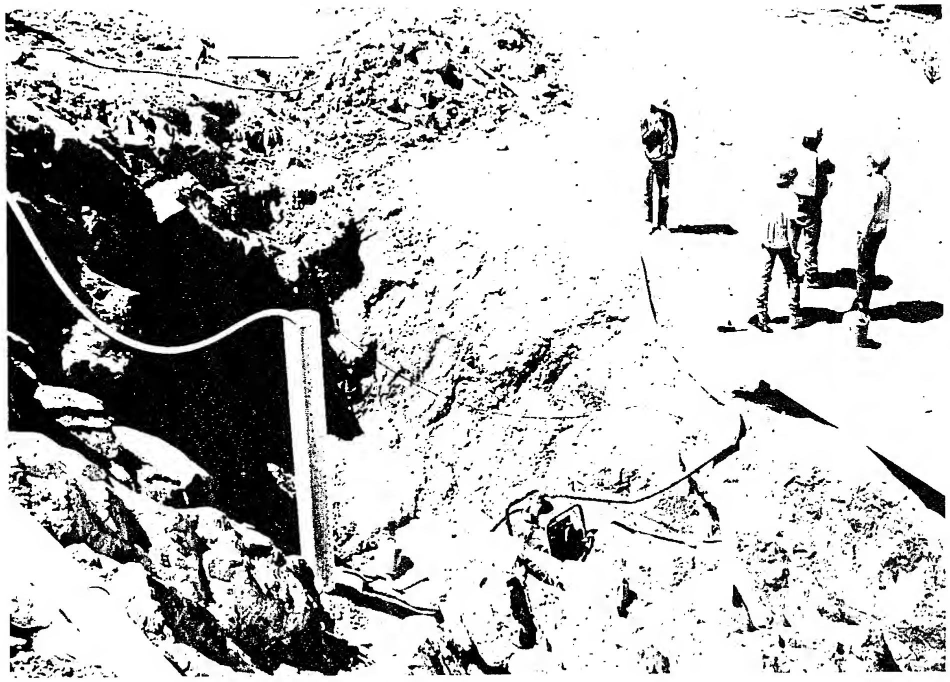


PHOTO CT7. Looking down and downstream at dental excavation used as dewatering sump at the base of the left abutment (near Station 14+00) near the downstream edge of the impervious fill foundation.

PHOTO CT8. Looking left and down into sump described above. The bags contain dry cement. Dental concrete was placed around the PVC. When the fill exceeded the head in the sump the PVC and gravel were grouted.

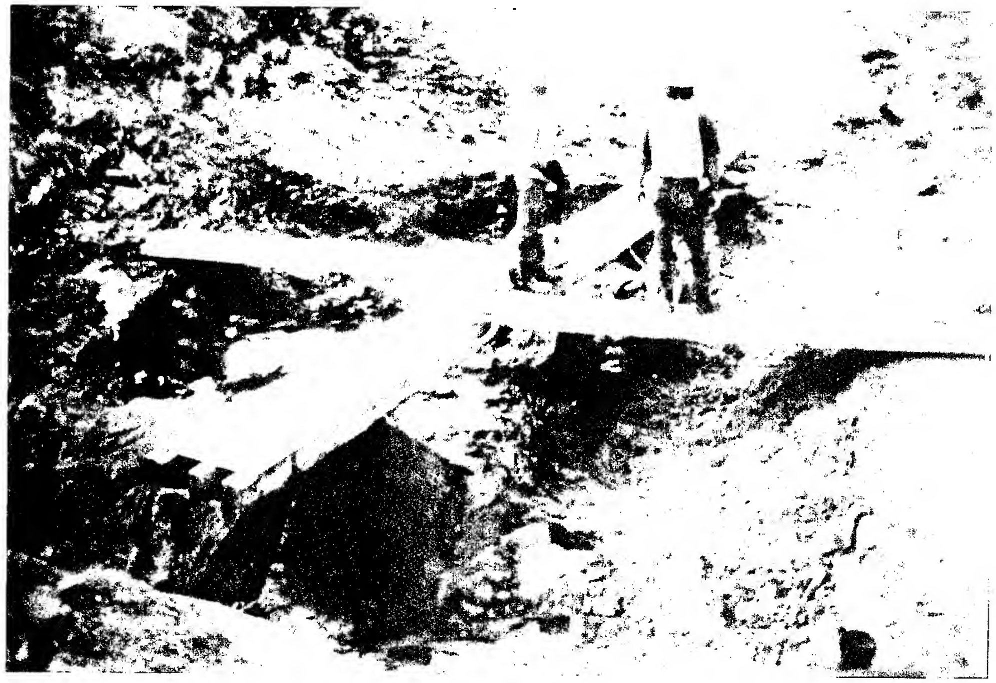


PHOTO CT9. Looking downstream at the base of the left abutment at area upstream of grout curtain prepared for dental/leveling concrete.

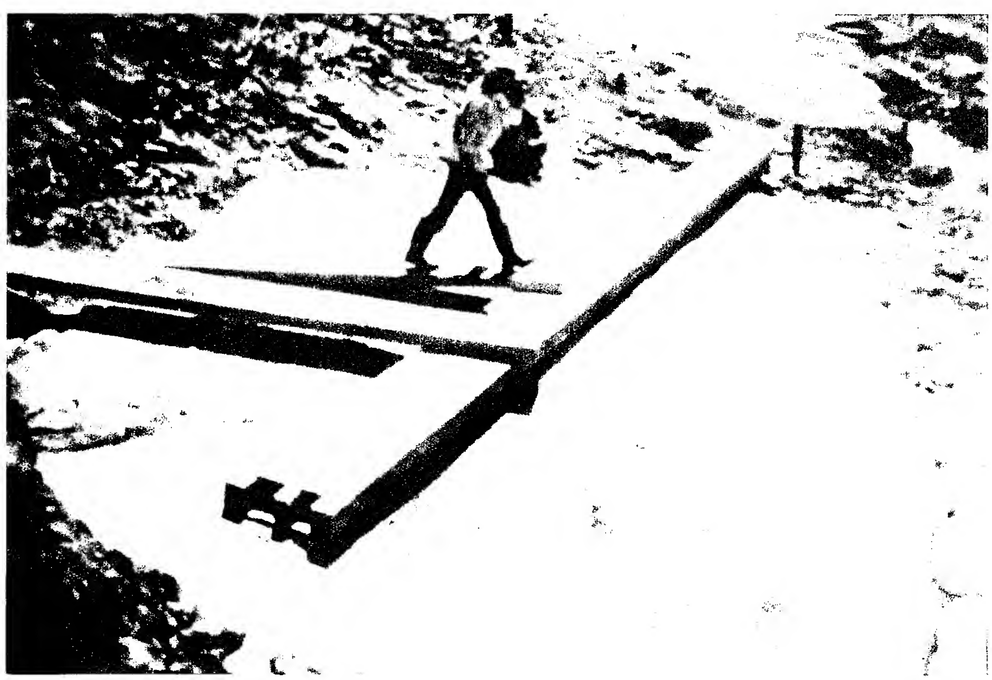


PHOTO CT10. Same area as previous photo. Note sand bags used to form edges to prevent "feathered" edges.

PHOTO CT11. Looking downstream at cleanup of core trench, preparing to place leveling concrete. Backhoe bucket is at about Sta. 15+40, 5 feet upstream of the dam axis.

PHOTO CT12. Same area as previous photo taken from further away. Grout nipples are in deepest area seen in the previous photo. Photo covers the core trench invert from Sta. 14+60 to 15+50.

PHOTO CT13. Looking downstream at the core trench foundation and leveling concrete on 9/18/90. Sta. 16+00 is in the middle of the photo. Refer also to the foundation treatment map.

PHOTO CT14. Looking downstream at the core trench foundation. Sta. 15+50 is in the middle of the photo.

PHOTO CT15. Looking downstream at the core trench foundation. Sta. 15+00 is in the middle of the photo.

PHOTO CT16. Looking downstream at the core trench foundation. Sta. 14+50 is in the middle of the photo.

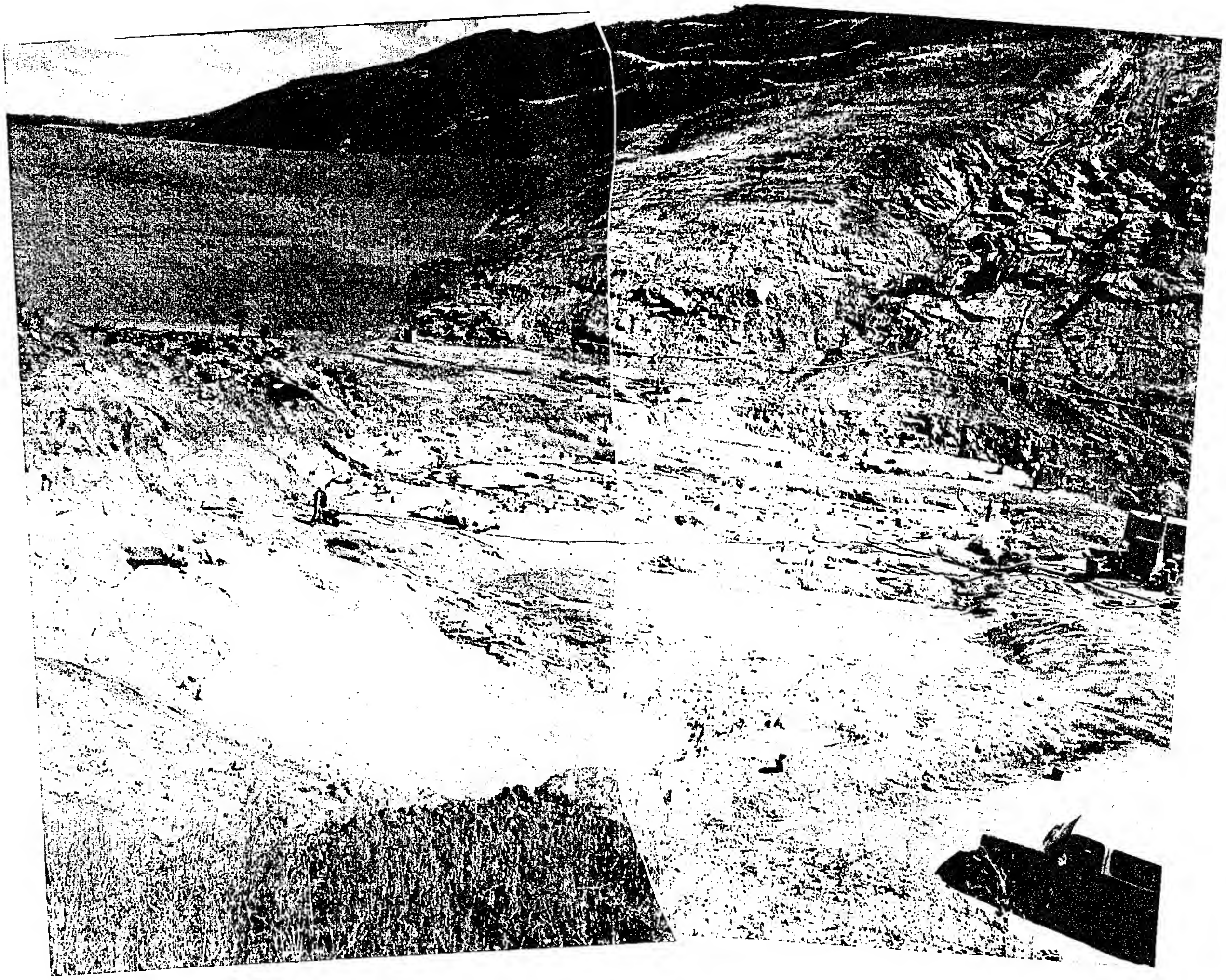


PHOTO CT17. Looking East at the core trench from the top of the downstream cut-slope near Station 17+00.

PHOTO CT18. Looking right from about Sta. 13+80. Contractor's crew is using a high pressure air nozzle to remove loose material from the core trench foundation at about Sta. 14+75 before beginning the first impervious fill placement.

PHOTO CT19. The first impervious fill placement at about Sta. 15+50 to 16+00.

PHOTO CT20. Looking left at the core trench foundation between Sta. 12+00 and 13+00, before final cleanup. Note overhangs resulting from rock breaking along bedding planes in hard sandstone layers. Corps of Engineers Geologist is in the center of the photo.

PHOTO CT21. Looking left at the left abutment core trench foundation at the toe of the upstream cut-slope. Inspection cleanup in preparation for placing concrete fillet to correct an overhang.

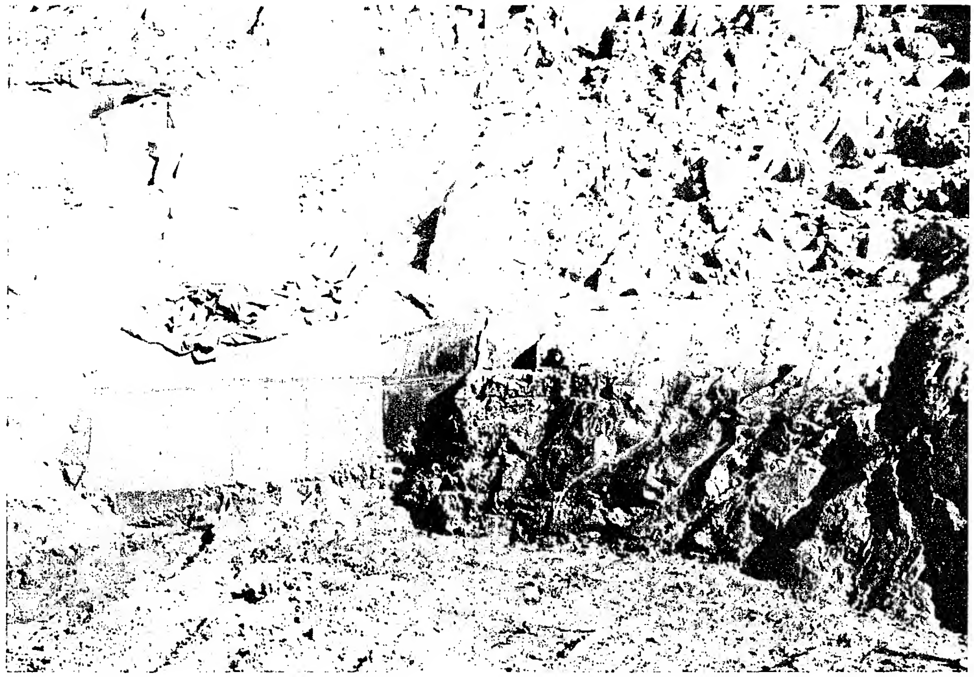


PHOTO CT22. Same area as the previous photo, after placing the fillet.

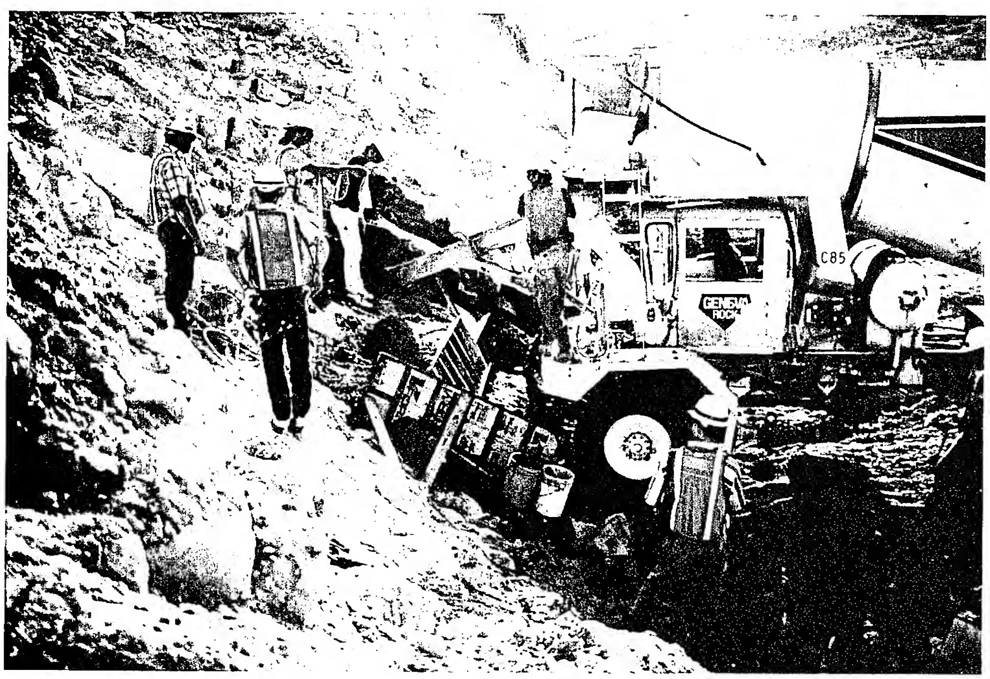


PHOTO CT23. Looking downstream at the placement of a concrete fillet at the left abutment core trench. Note form on near end to prevent thinning (feathering out) at the ends of the fillets.

PHOTO CT24. Looking left at the same area as the previous photo. Crew is working on mortaring joints marked with green paint.

PHOTO CT25. Looking left at the left abutment core trench. Area 092892A (see the Foundation Approval Map) approved below the horizontal orange lines. Green paint marks numerous fractures in hard blocky sandstone which require mortaring before placing fill.

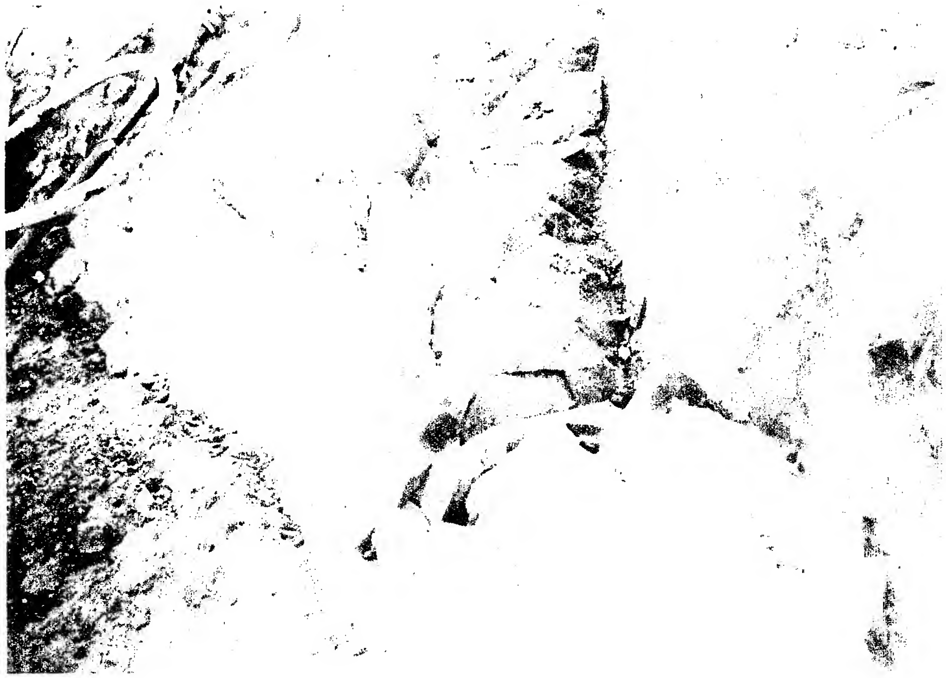


PHOTO CT26. Fine fractures in a siltstone bed marked for mortar.

PHOTO CT27. Same description as previous photo.

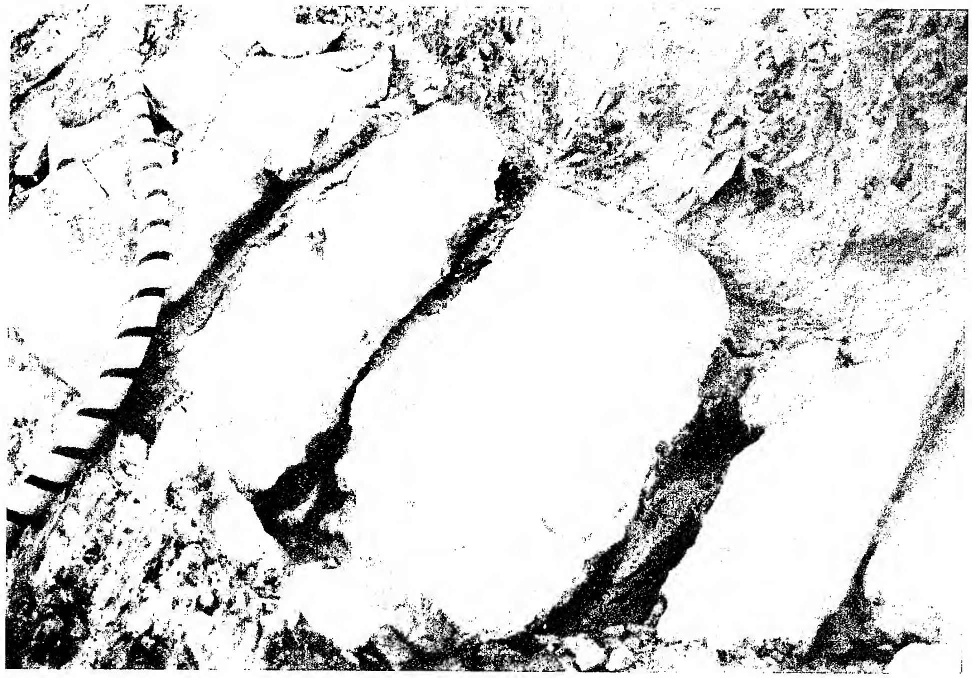


PHOTO CT28. Large open fractures in a 2-foot thick hard sandstone bed, after mortaring fractures. Left abutment core trench, Sta. 11+10 at toe of upstream cutslope.

PHOTO CT29. More distant view of the area in the previous photo.

PHOTO CT30. Looking downstream near Sta. 18+00 in the core trench. Crew completes final preparation of foundation in an area where little or no joint mortaring was required (see also the Foundation Treatment Map). The Mesco front-end loader is performing wheel rolling of impervious fill against a previously approved area to the left.

PHOTO CT31. Looking upstream from the grout curtain (15 feet upstream of the dam axis) at an area near Sta. 21+60. Gray stringers are grout filled fractures. Excessive pressure was apparently used at this location, resulting in some lifting of the foundation. The fractures were filled with dense grout and no harmful effects resulted. This photo shows an area typical of the conditions where the soft rock was intensely fractured, but the fractures were tight and no joint mortaring was required.

PHOTO CT32. Looking upstream at an area of the core trench foundation near the toe of the upstream cutslope, Sta. 22+05. The crew is spreading dry cement on area of numerous small seeps immediately before placing impervious fill.

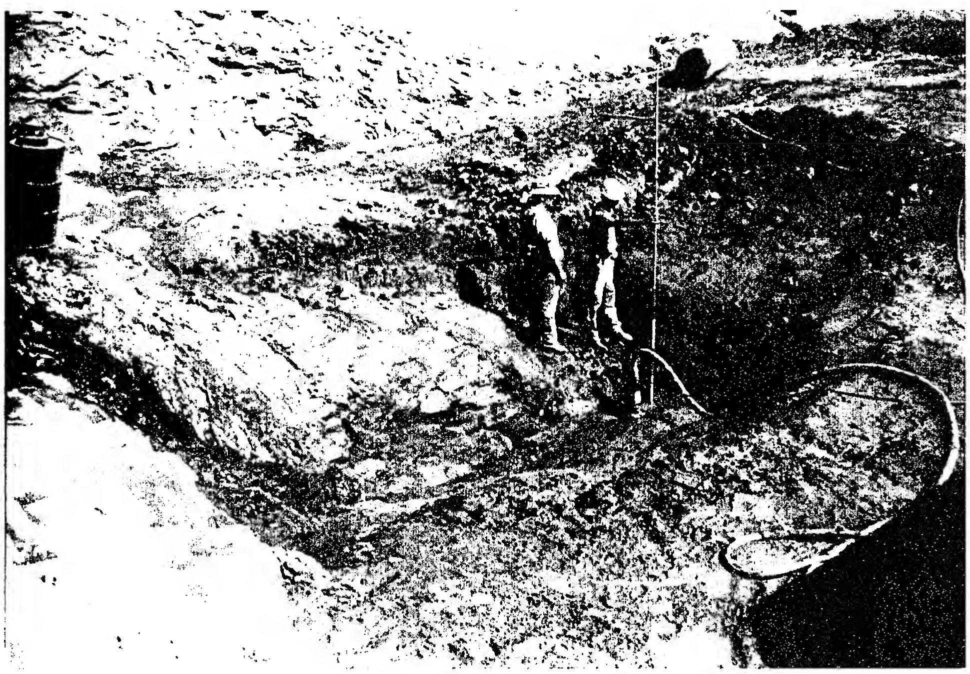


PHOTO CT33. Excavation for sump 38 feet upstream of the dam axis at Sta. 23+40. Looking upstream and left from Sta. 23+50 on the dam axis.

PHOTO CT34. Looking left from about Sta. 23+60. Howie Aubertin, Corps of Engineers Assistant Resident Engineer, with rock hammer pointing to substantial flow from a spring which flows down to the sump below. A worker is using hand operated equipment to compact the gravel in the sump.

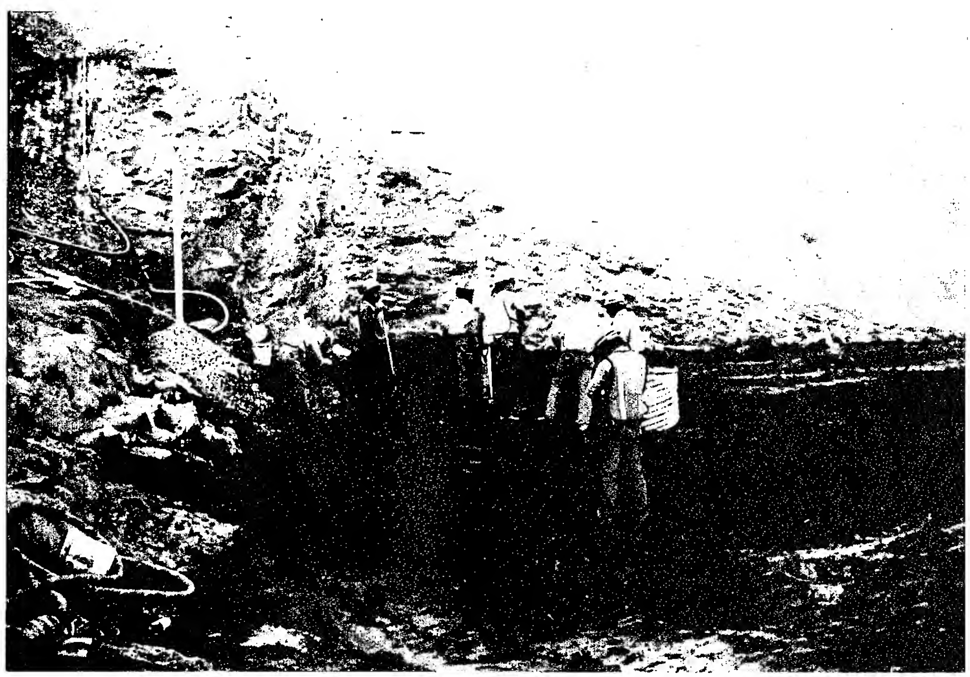


PHOTO CT35. Looking upstream along Sta. 23+50 at sump. Note the 24-inch-diameter CMP and two 4-inch diameter PVC pipes installed to facilitate grouting the sump later. Also note the gravel collector extending up to the spring shown in the previous photo.

PHOTO CT36. Area below the feet of the workers where a limited amount of slush grout was utilized. Area extends upstream from the dam axis at Sta. 23+50.

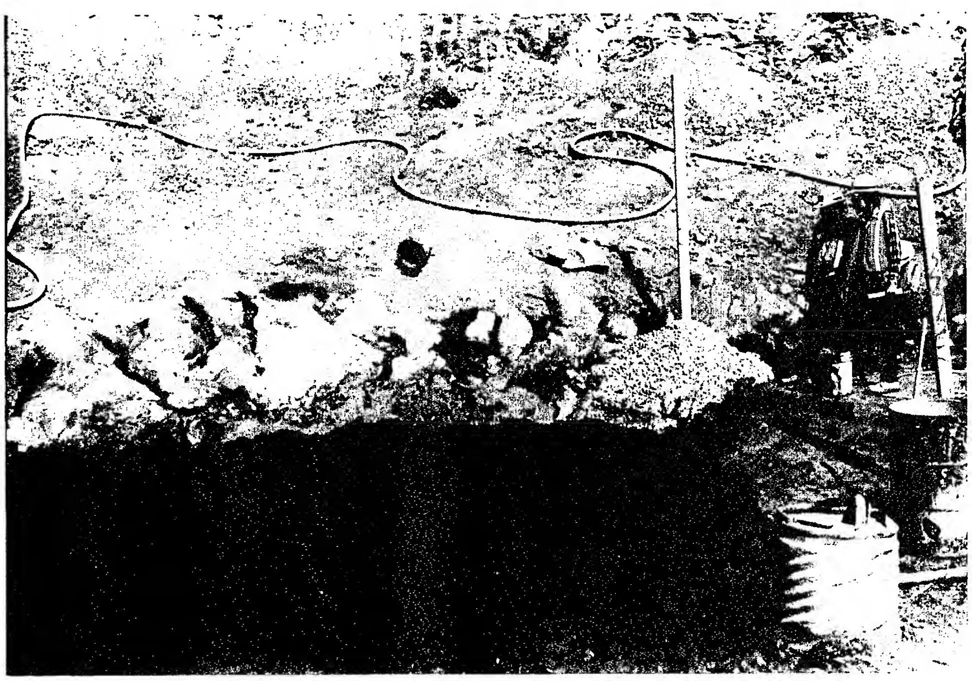


PHOTO CT37. Area in previous photo after placing slush grout over an area of about 4-feet by 10-feet.

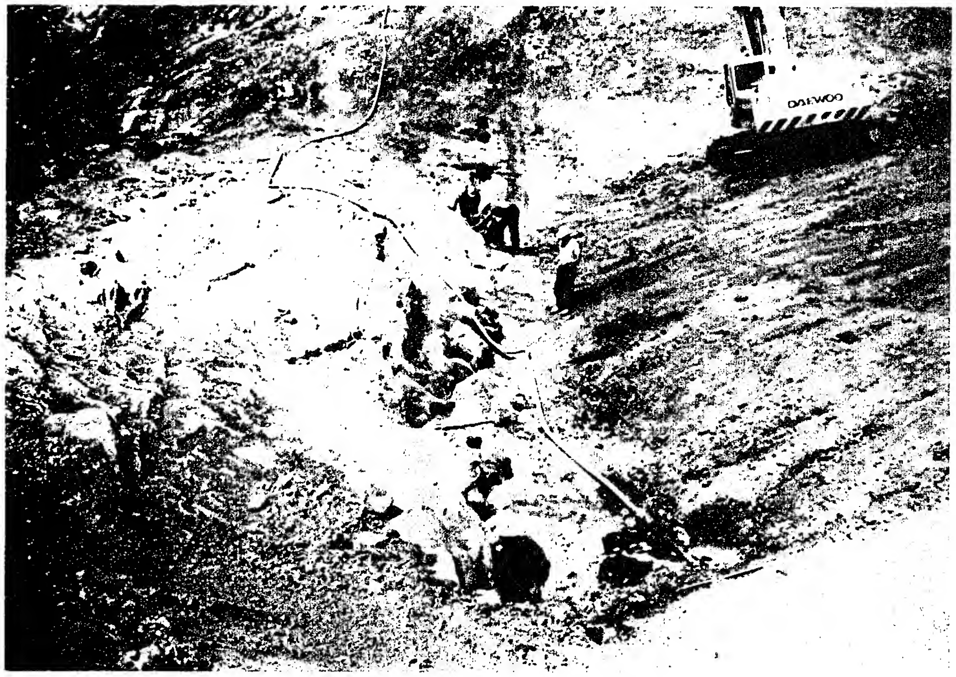


PHOTO CT38. Looking upstream at excavation of anomalous soft zones within hard sandstone bed crossing the dam axis between Sta. 20+05 and 20+15.

PHOTO CT39. Same area as the previous photo after placing dental concrete in the holes created by excavating the soft material.

PHOTO CT40. Anomalous soft zone at left edge of the photo in a hard blocky sandstone layer at the downstream edge of the impervious core foundation near Sta. 20+70. The soft material was hand excavated and replaced with concrete.

PHOTO CT41. Anomalous soft zone in a hard blocky sandstone layer at the downstream edge of the impervious core foundtion near Sta. 20+70. The soft material was excavated and replaced with concrete.

PHOTO CT42. Anomalous soft zone in hard blocky sandstone layer at the downstream edge of the impervious core foundation near Sta. 20+70. The soft material was hand excavated and replaced with concrete.

PHOTO CT43. Looking right at Sta. 25+90 in the core trench. Note numerous joints mortared in this softer rock area.

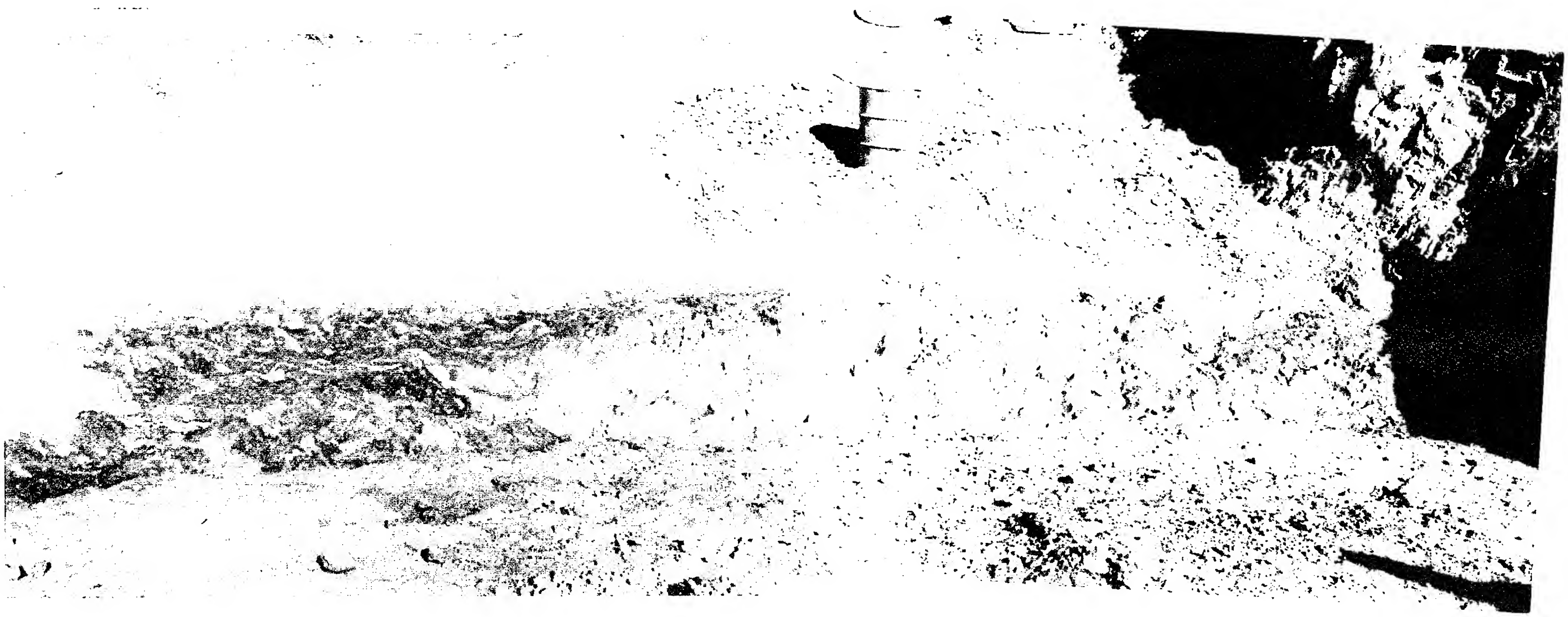


PHOTO CT44. Looking right at Sta. 26+95 in the core trench. Photo is typical of soft rock areas where moderate amounts of joint mortaring were required in softer rock areas.

PHOTO CT45. Looking upstrea
cutslope at the Station 22 F

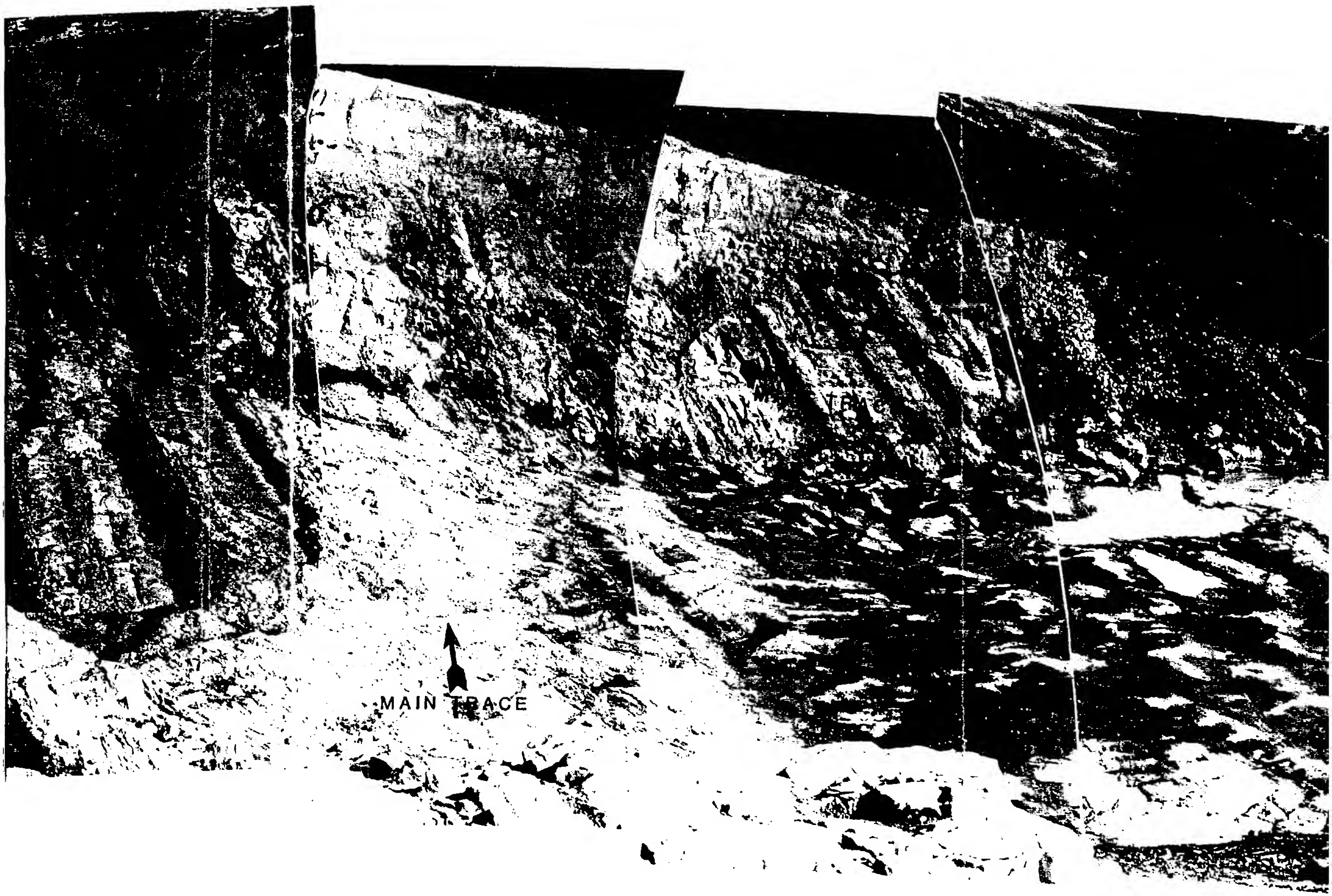
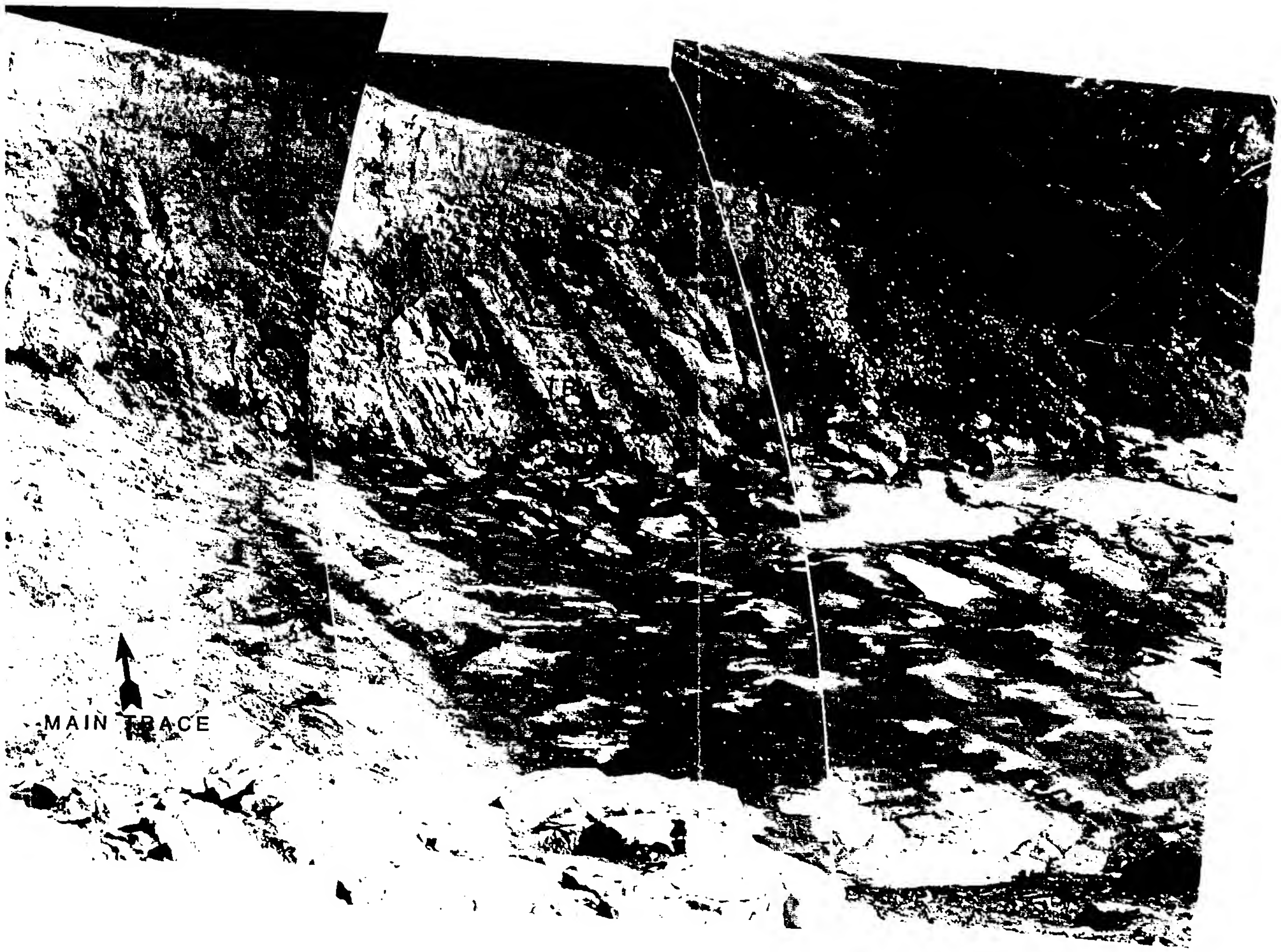


PHOTO CT45. Looking upstream from the top of the downstream cutslope at the Station 22 Fault Zone.



' upstream from the top of the downstream
ion 22 Fault Zone.

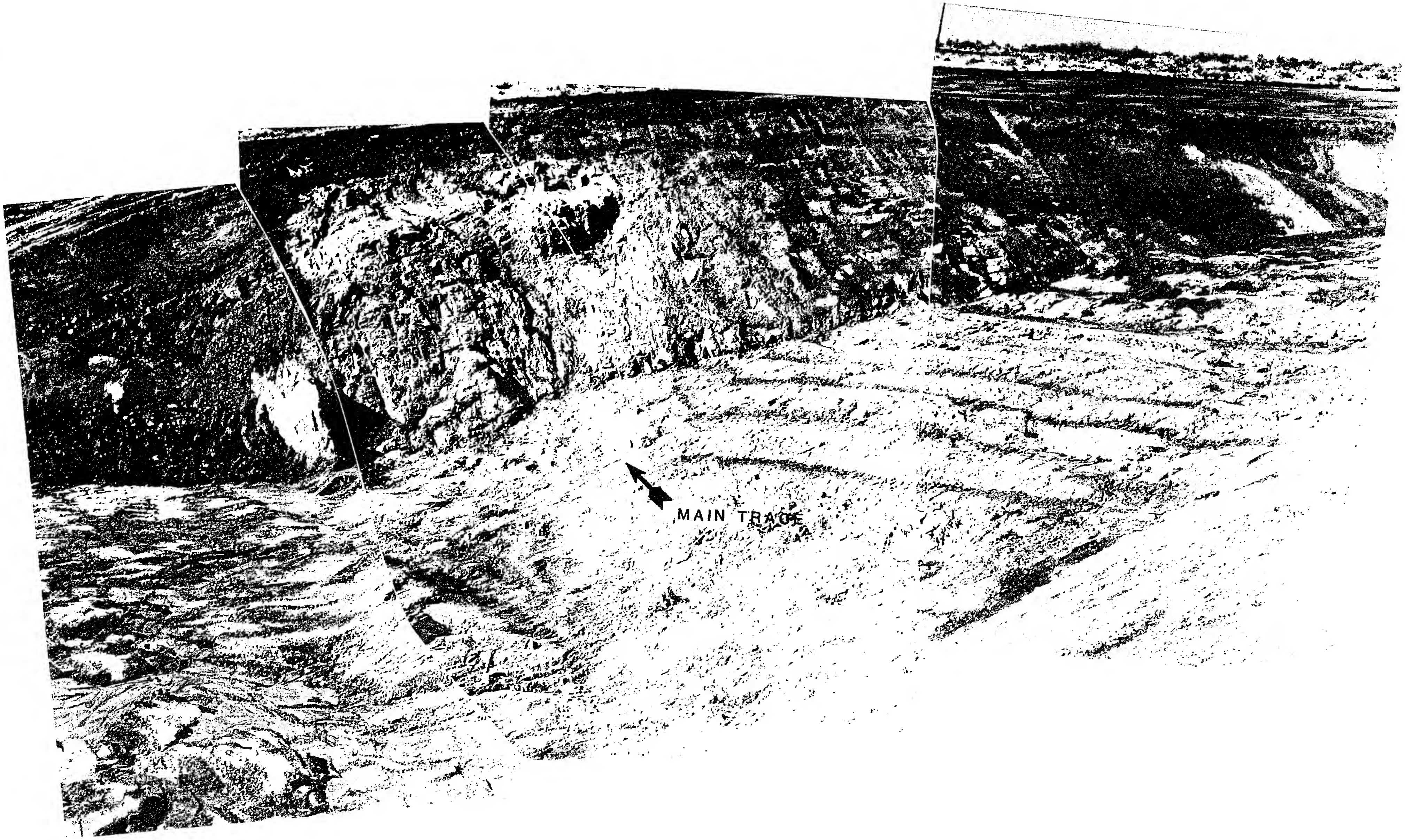


PHOTO CT46. Looking downstream from the top of the downstream cutslope at the Station 22 Fault Zone.

PHOTO CT47. Looking upstream at the Station 22 Fault in the upstream cutslope where the fault is covered by the Upper Gravel Layer of the Older Alluvium.

PHOTO CT48. Close-up view of the fault where it is covered by Older Alluvium. The fault ends at the bottom of the alluvium in the center of the picture.

PHOTO EMB1 (Embankment Foundation 1). View of the right abutment from the left abutment before beginning excavation of the core trench.

PHOTO EMB2. The right abutment in the summer of 1988 after beginning excavation of the core trench.

PHOTO EMB3. The right abutment after striping was completed in 1989.

PHOTO EMB4. View of the left abutment after beginning the core trench excavation in 1988.

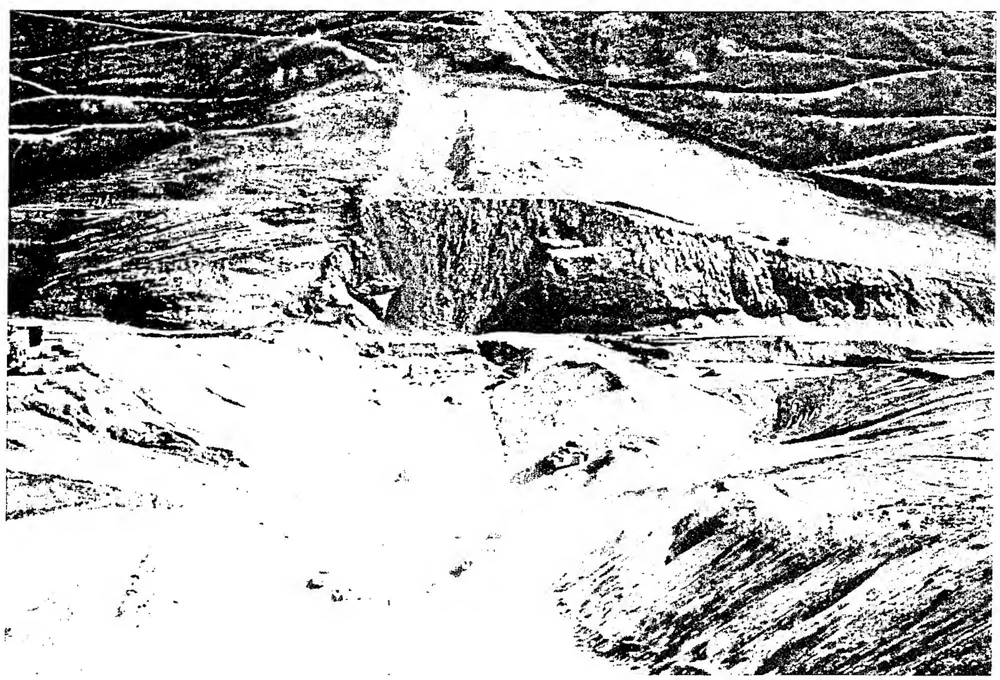


PHOTO EMB5. The left abutment on 10/23/89. The abutment has been stripped and excavation of the overburden at the downstream shell foundation is in progress.

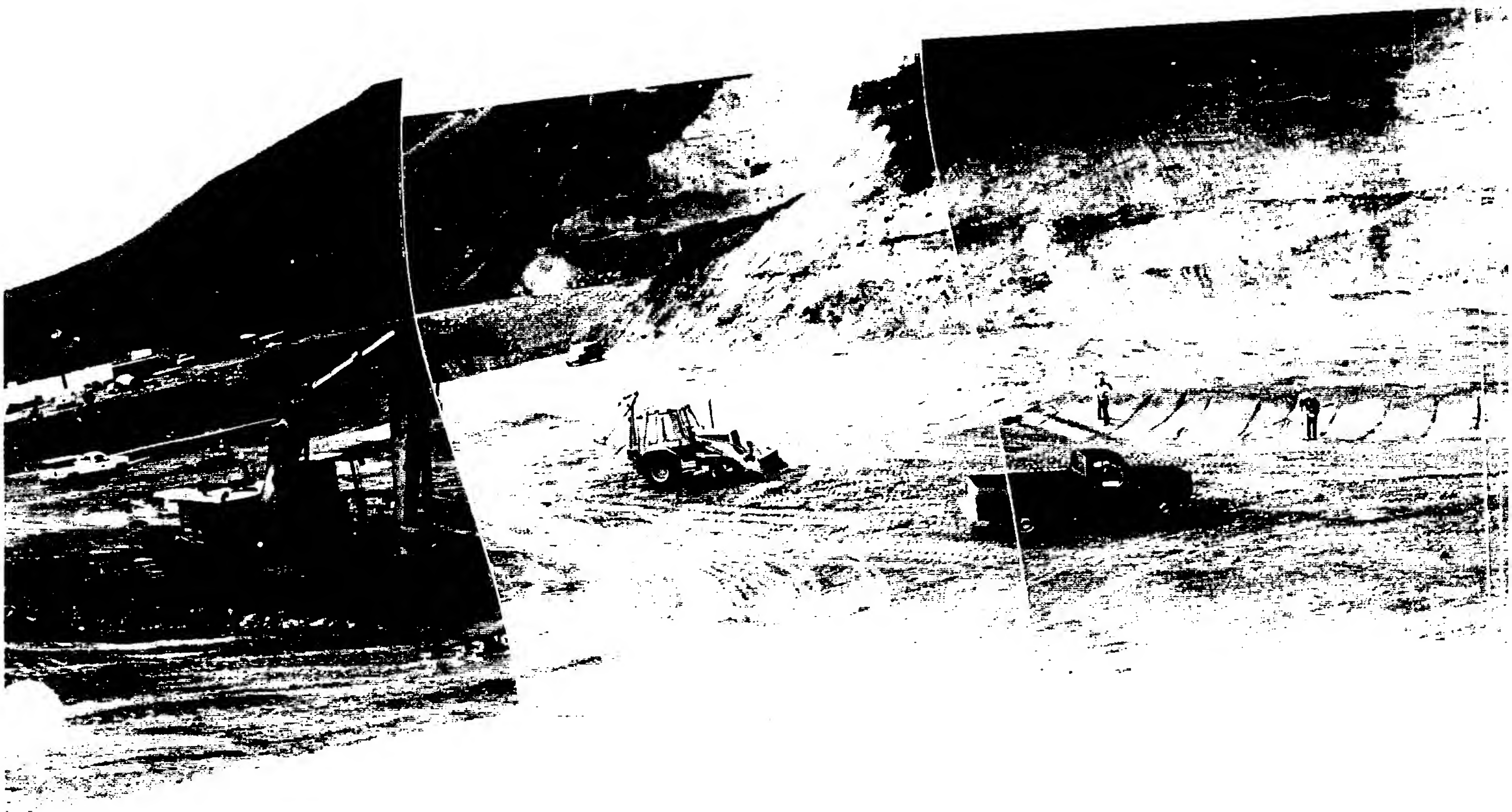
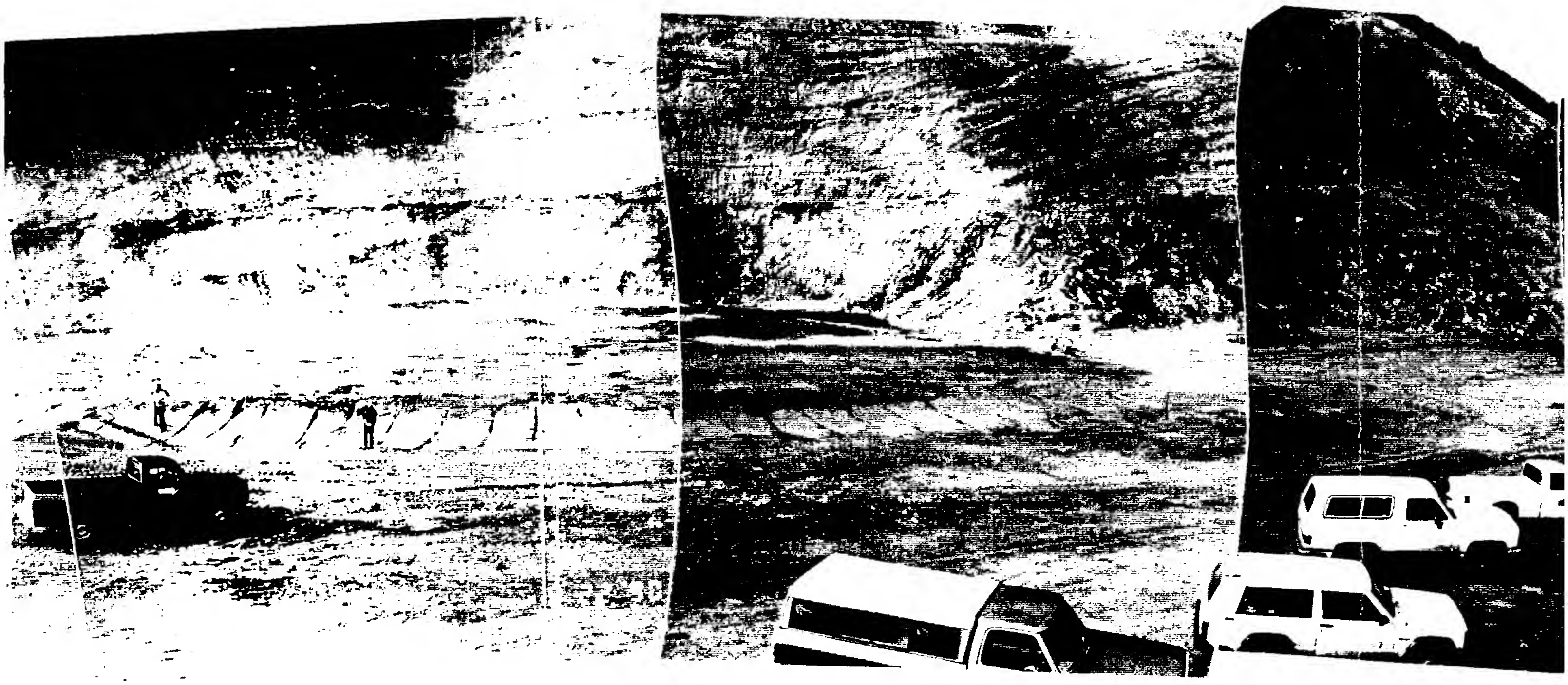
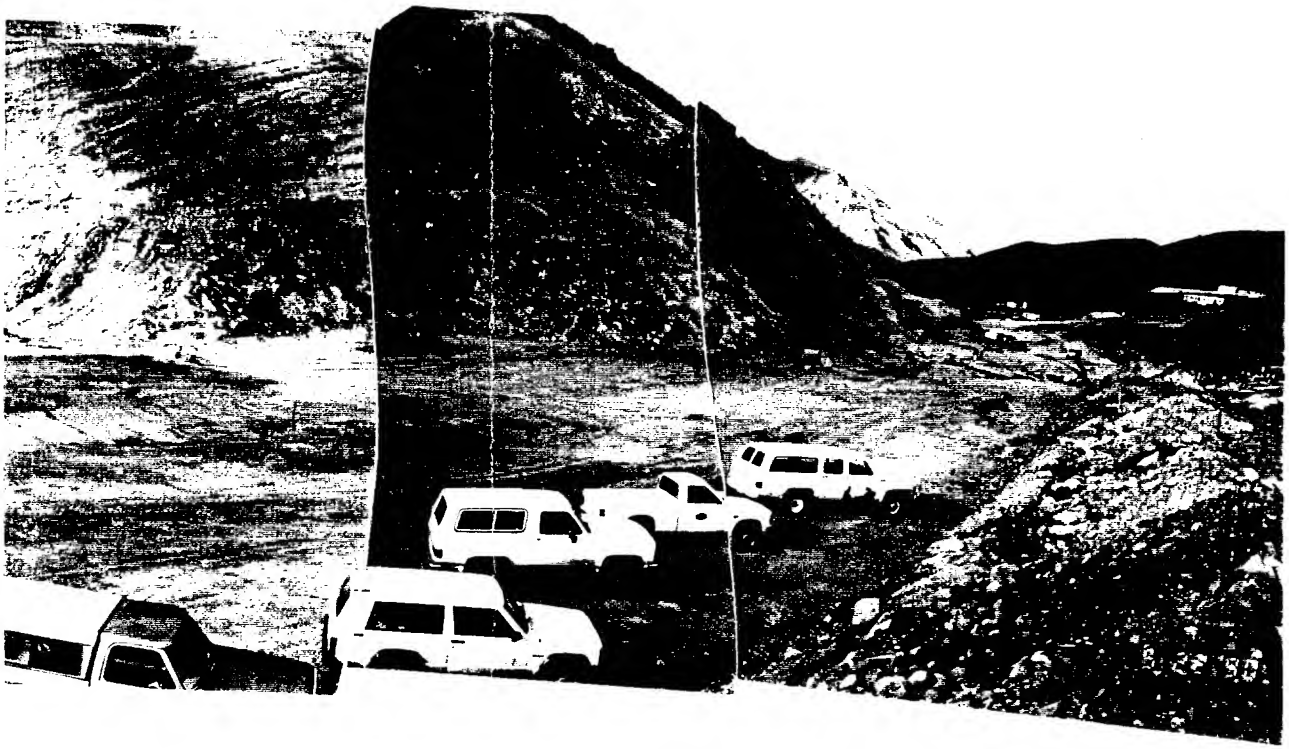


PHOTO EMB6. Looking left (northeast to southeast) at t
the upstream shell foundation approved as "Area G" (5-1
Excavation and proof-rolling has been completed in this
the maximum section of the dam will be founded.



: (northeast to southeast) at the portion of
ation approved as "Area G" (5-30-90).
ling has been completed in this area on which
ne dam will be founded.



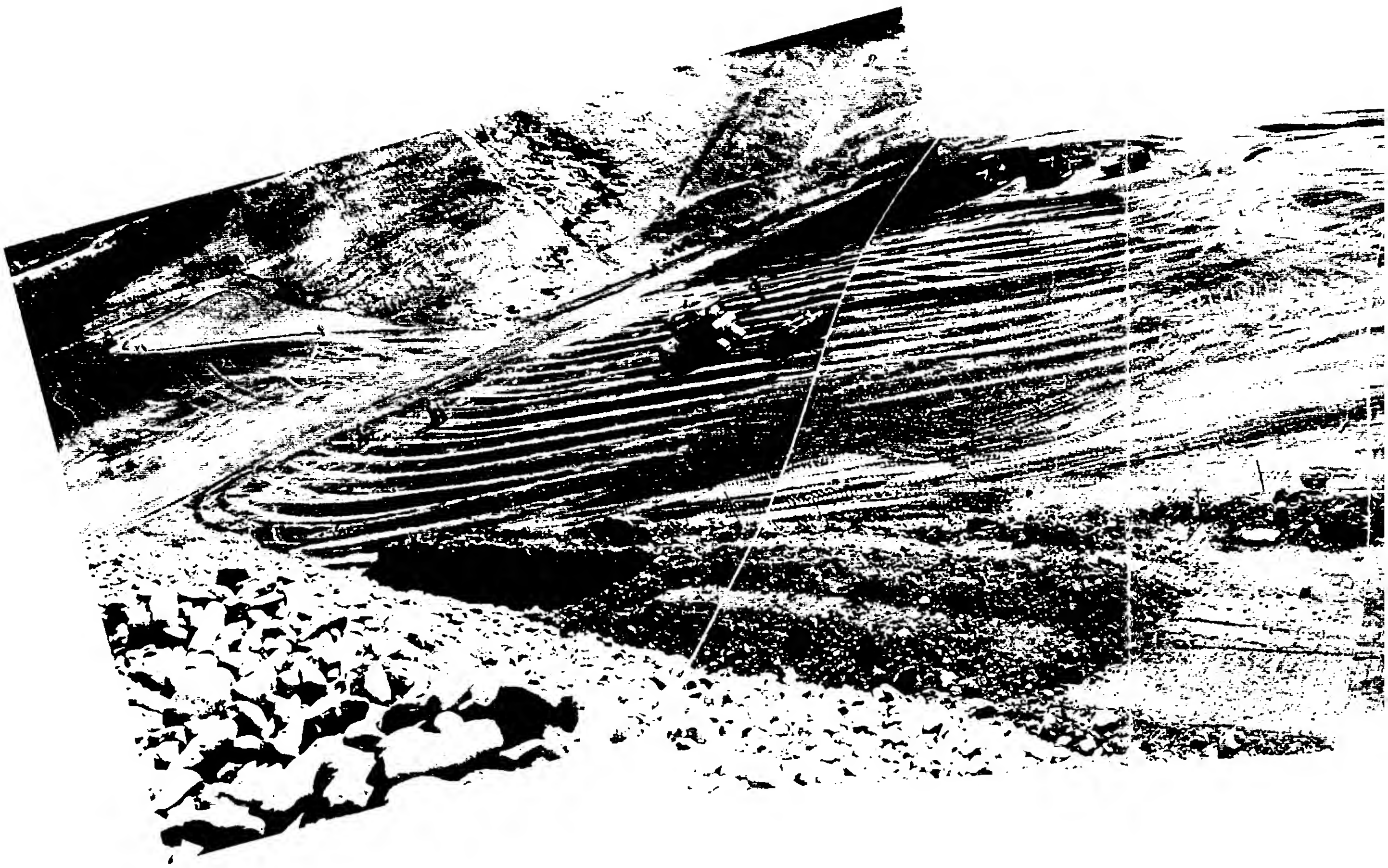
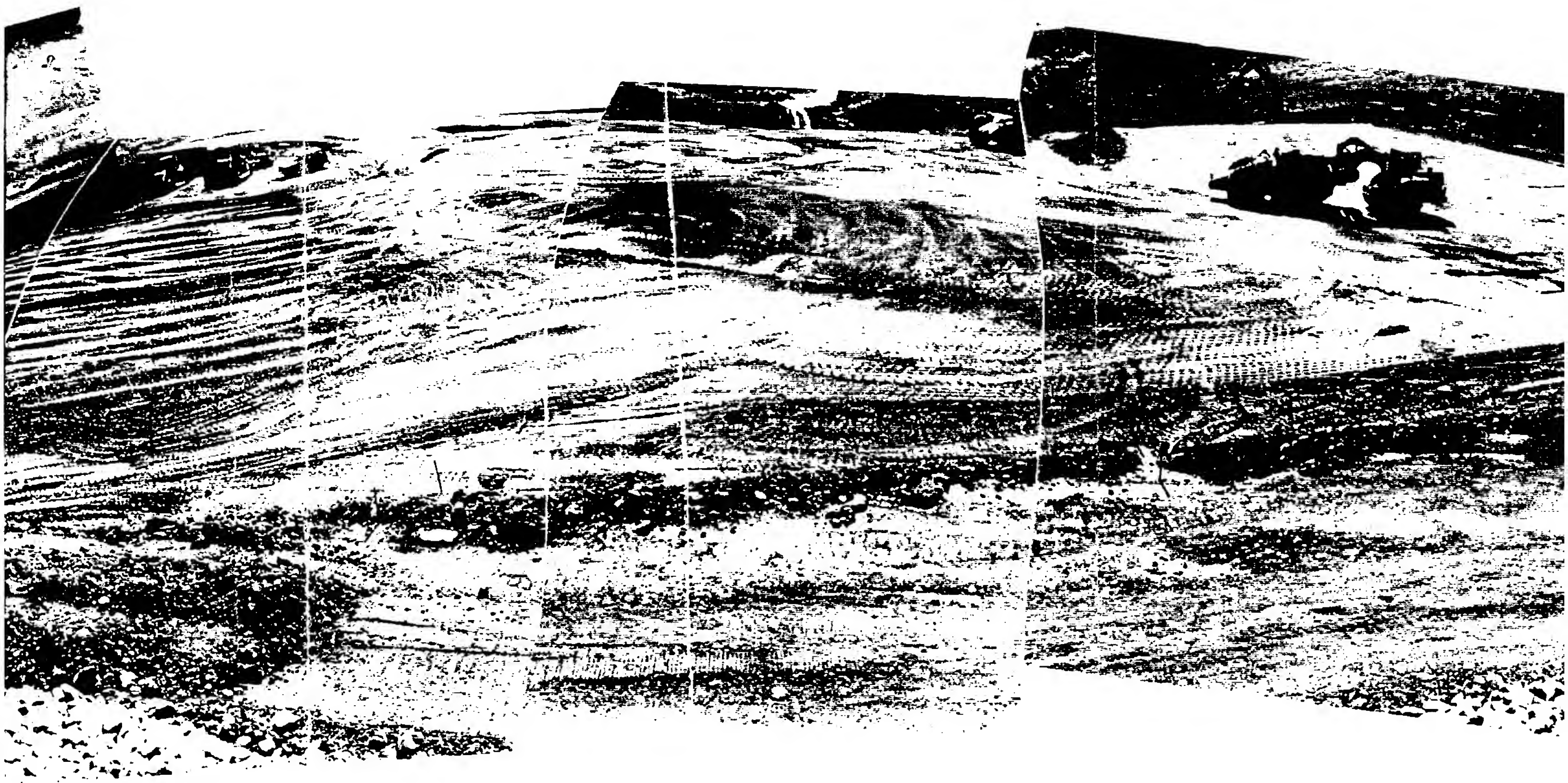
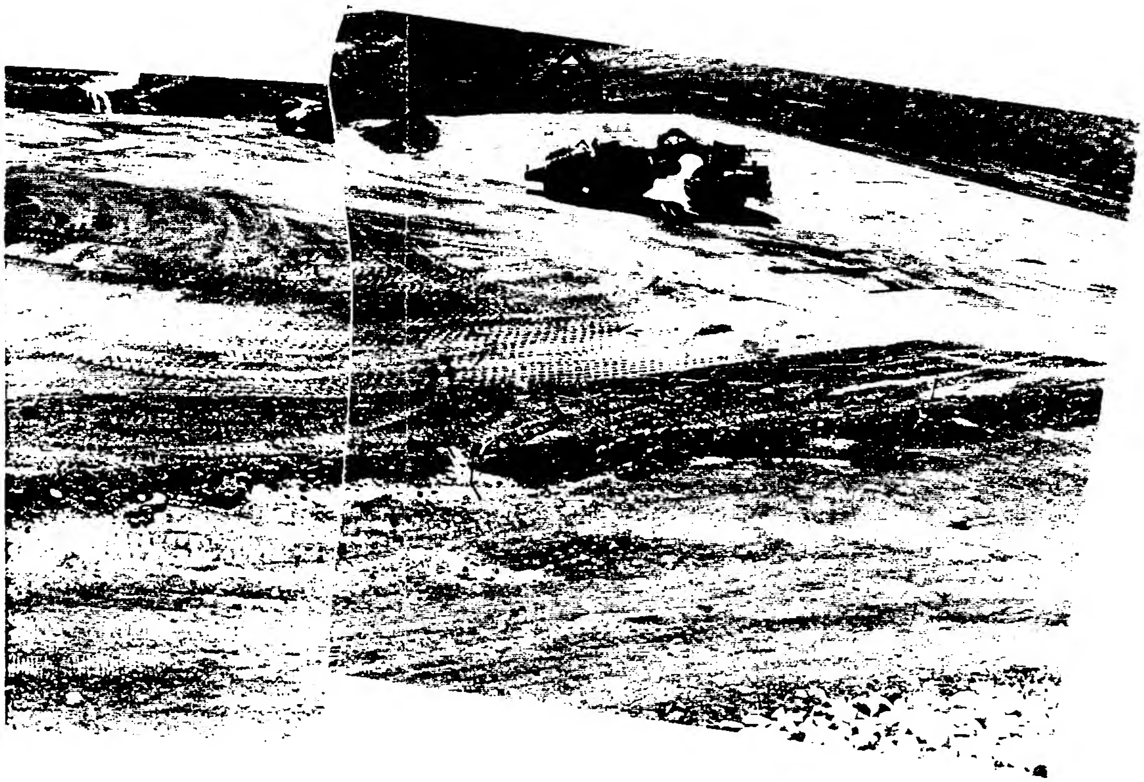


PHOTO EMB7. Looking south at the portion of the upstream shell foundation approved as "Area X" (9-4-90). Rockier Random II fill wa requested for this area where the foundation consisted of the weakes materials within the dam foundation.



tion of the upstream shell
90). Rockier Random II fill was
ndation consisted of the weakest



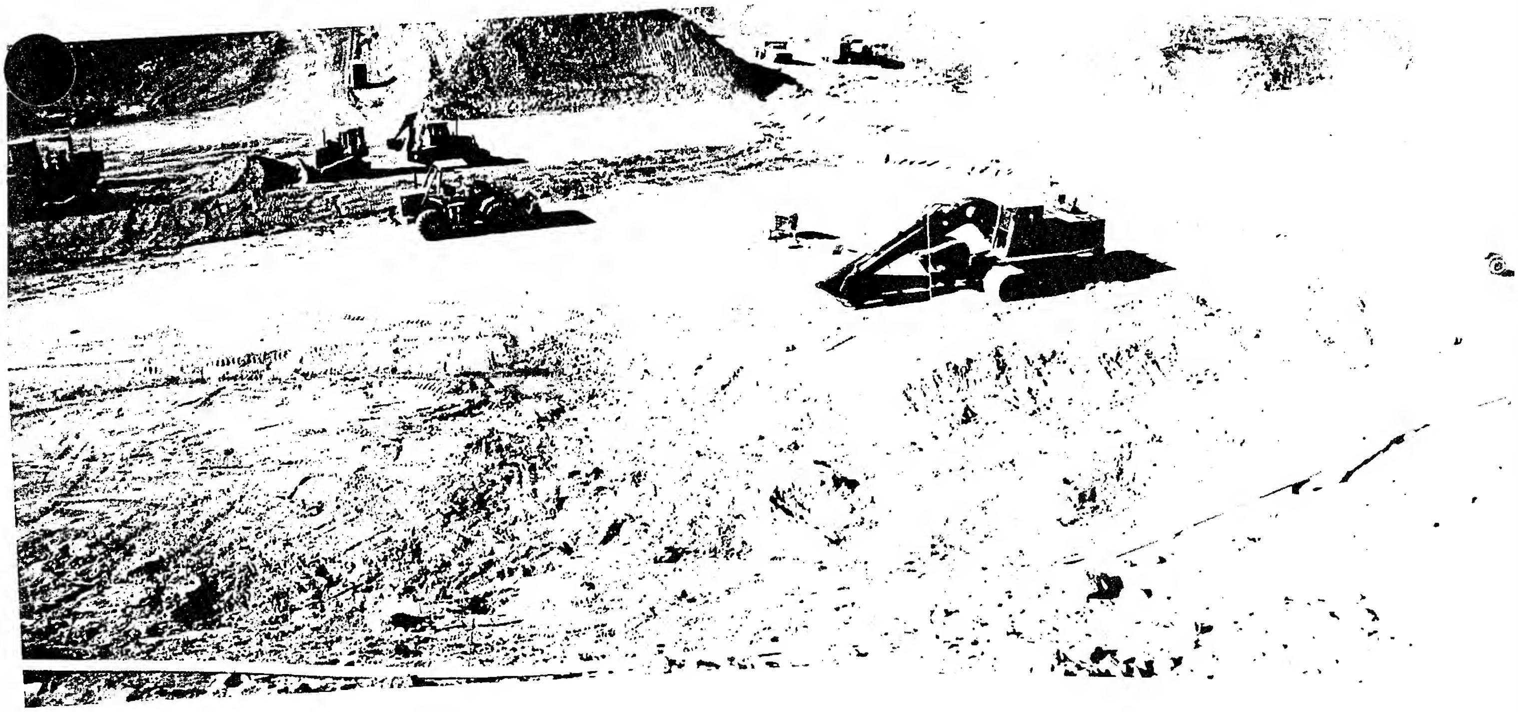


PHOTO EMB8. Looking right at the upstream portion of the downstream shell foundation approved as "Area AB" (5-4-90).

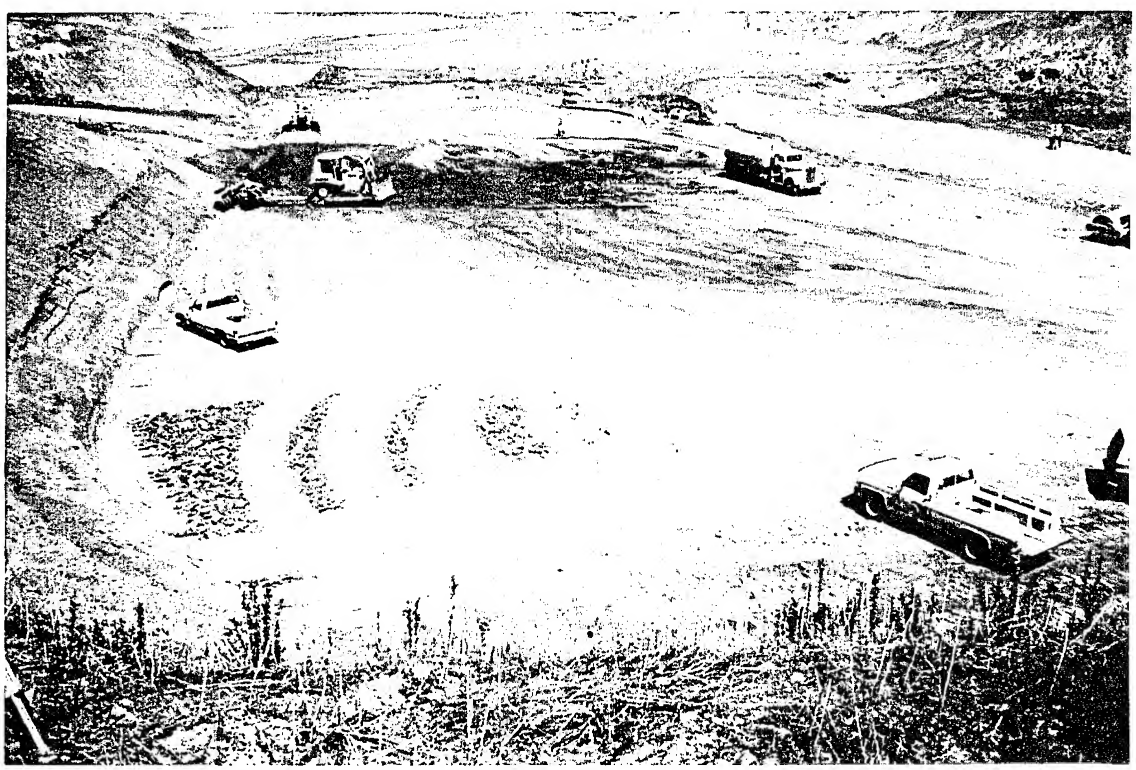


PHOTO EMB9. Looking upstream at the portion of the downstream shell foundation approved as "Area 051691A"

PHOTO EMB10. Looking downstream along the downstream right abutment as Transition 1 is placed on the area approved as "Area 051792b"

PHOTO EMB11. Looking downstream along the downstream left abutment as Transition 1 is placed on approved foundation.

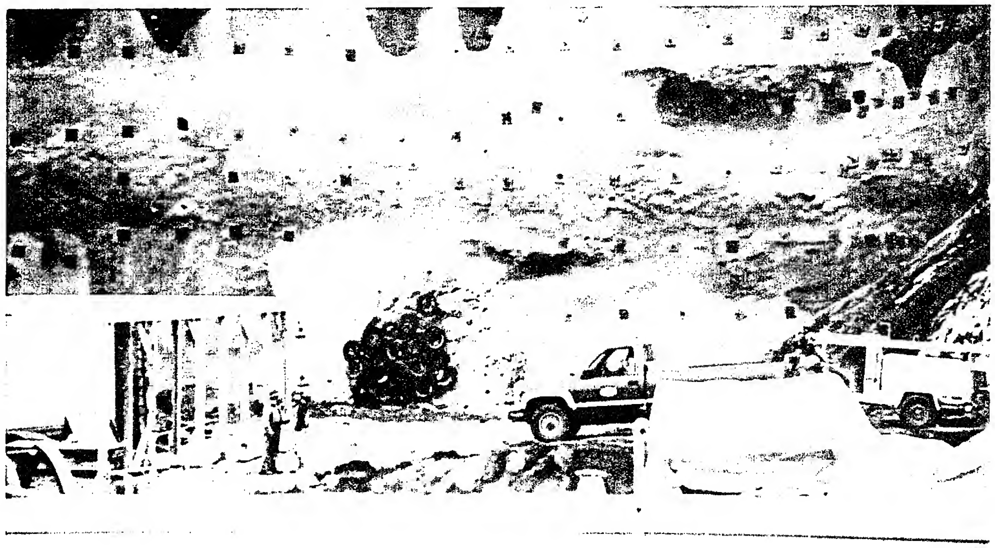


PHOTO T1 (Tunnel 1). Downstream portal of outlet works tunnel before blasting the first round. Blasting mat made of old tires was used to reduce "fly rock".

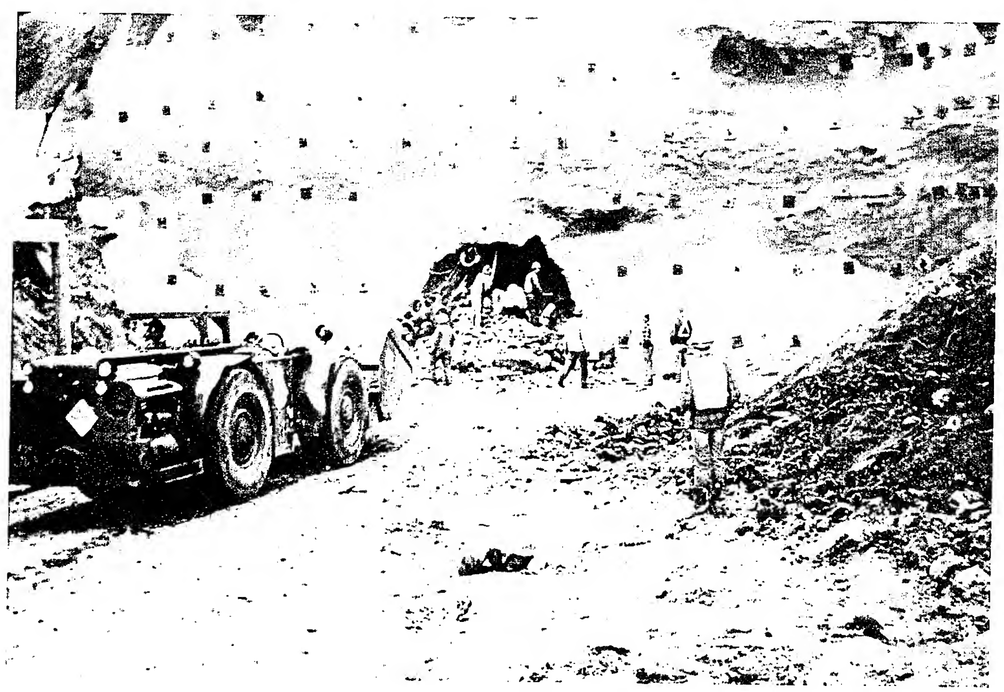


PHOTO T2. Same area as previous photo, after blasting first round.

PHOTO T3. Looking upstream at area mapped as face No. 97 at Sta. 25+98. Two-boom jumbo is drilling blast holes in at heading.

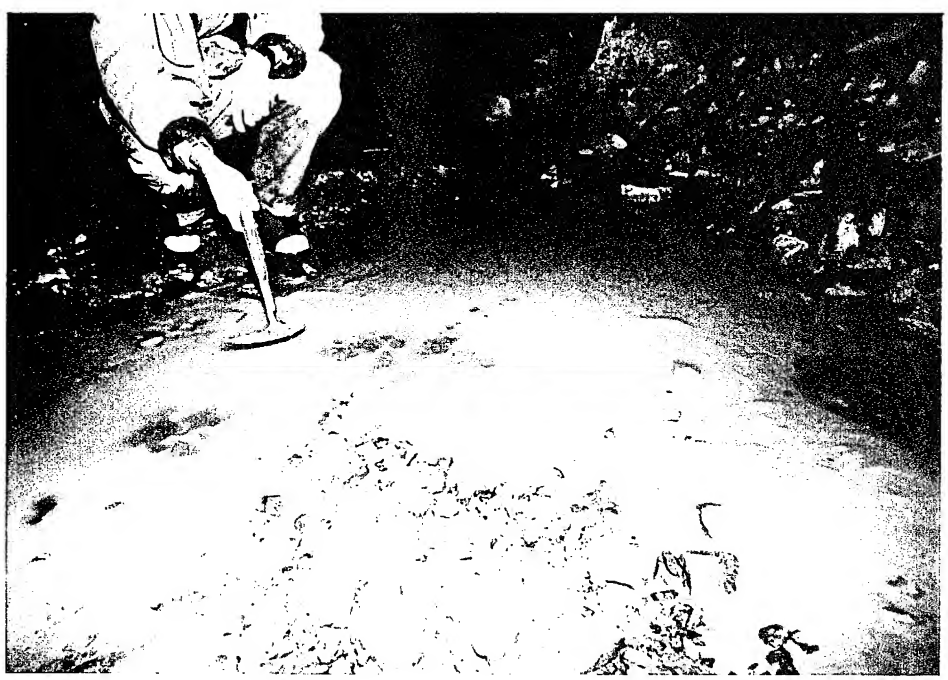


PHOTO T4. Dark areas are water seeping up from the invert near Sta. 22+98.

PHOTO T5. Looking upstream at area mapped as face No. 70 at Sta. 21+96. Montmorillonitic clay layer did not fragment properly when blasted, causing damage to several sets already in place.

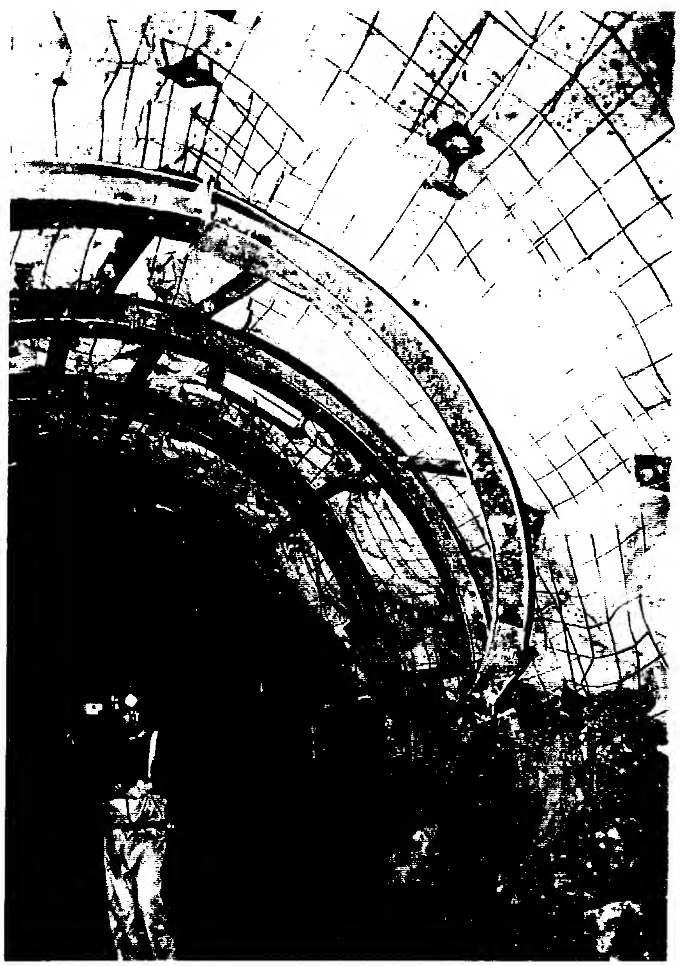


PHOTO T6. Damaged sets at area described in previous photo.

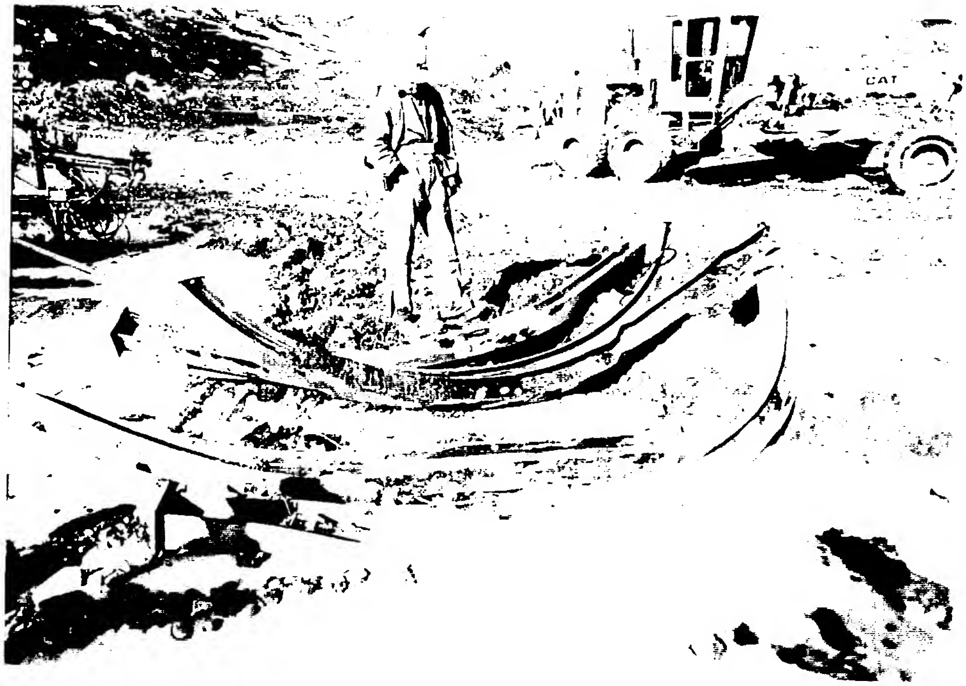


PHOTO T7. Damaged sets after being removed from tunnel.

PHOTO T8. Pattern of blast holes drilled in heading.

PHOTO T9. Using a jackleg drill to install a tunnel strap in the crown of the excavation at Sta. 11+70.

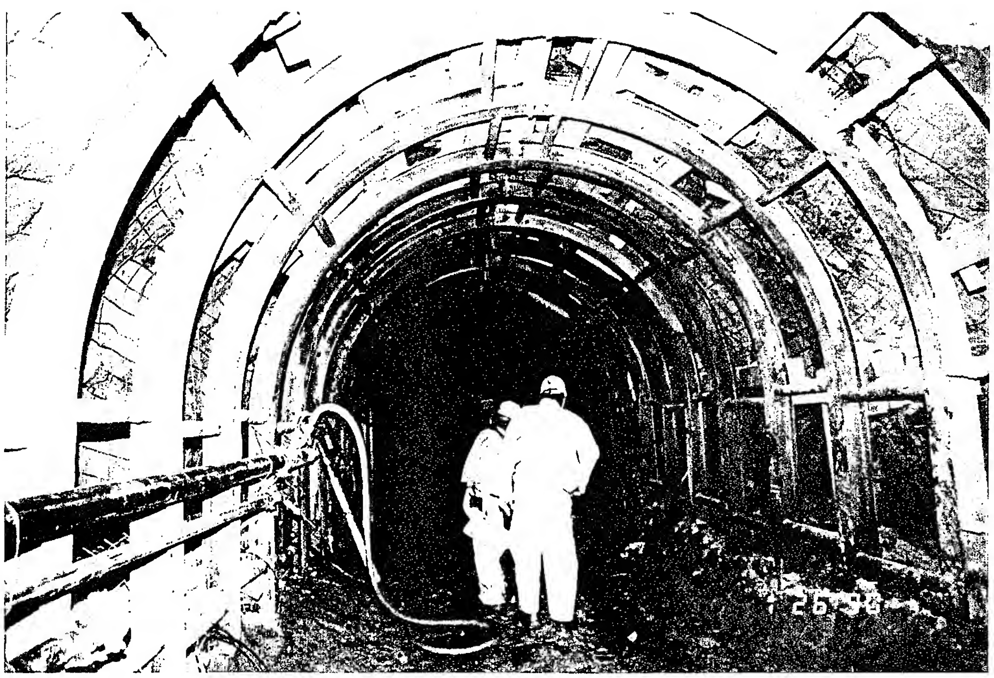


PHOTO T10. Looking upstream in the downstream adit. Tunnel sets, blocking and shotcrete were used as initial support. Shotcrete ends in the near view.

PHOTO T11. Woodblocking constructed in "log cabin" type configuration to allow concrete to flow around and between timbers.

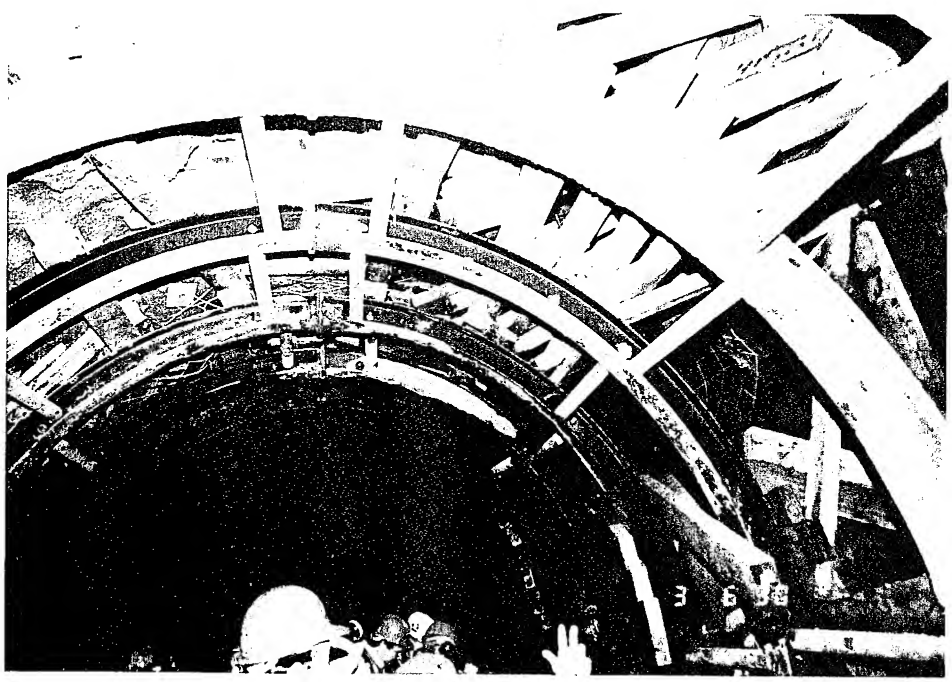


PHOTO T12. Looking upstream and to the left (southeast) side of the tunnel at the Set 263 Fault. Farthest set is set 262 at about Sta. 18+58. Note extensive wood blocking.

PHOTO T13. Same area as previous photo. Looking lower and more toward the side of the tunnel. Yellow material is fault gouge and breccia.

PHOTO T14. Same area as previous photo, after applying shot-crete. Last set on left is No. 261.

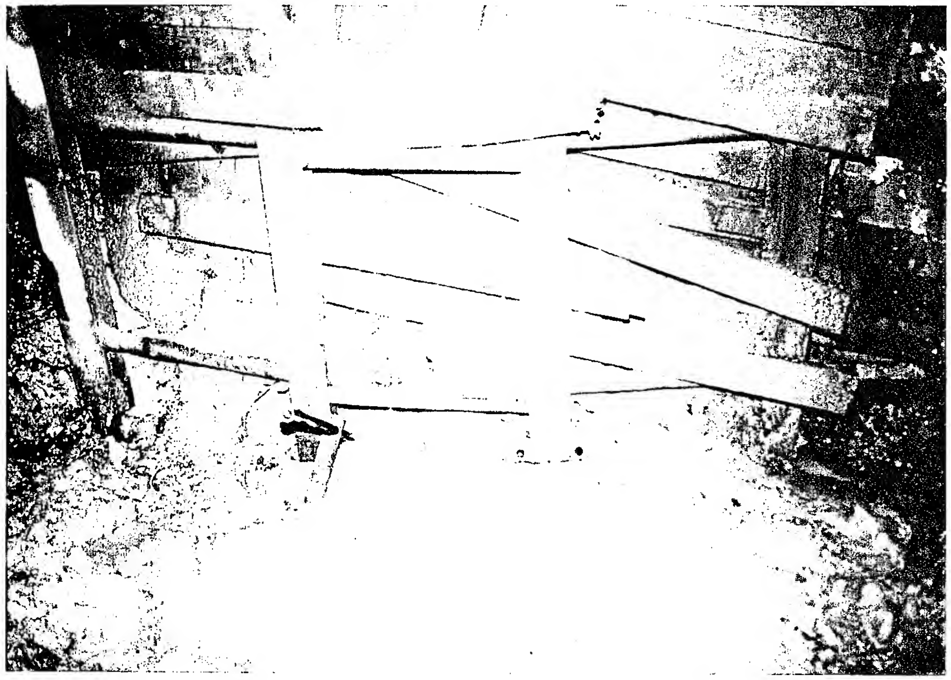


PHOTO T15. Same area as previous photos. Looking more directly at lower part of left side of tunnel. Yellow material at bottom of sets is fault gouge. Water flowing from fault was visually estimated at greater than 20 gpm.

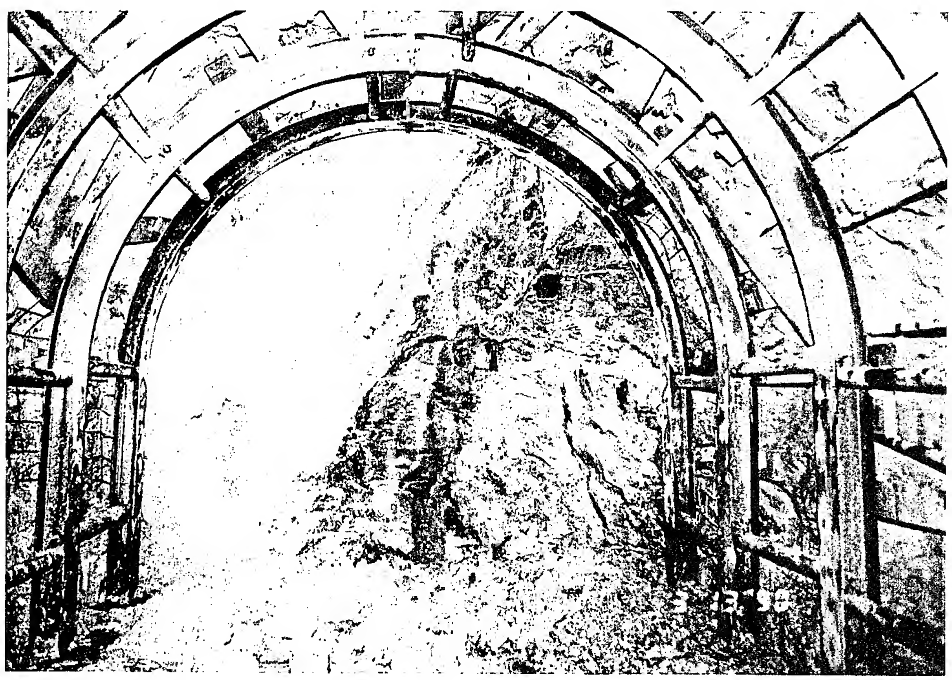


PHOTO T16. Looking upstream at the Set 263 Fault in heading at about Sta. 18+32. Yellow-brown clay gouge and breccia slope across the left side of the photo.

PHOTO T17. Looking upstream at the north side of the tunnel near Sta. 17+95. Note spilling installed to pre-support the brecciated zone.

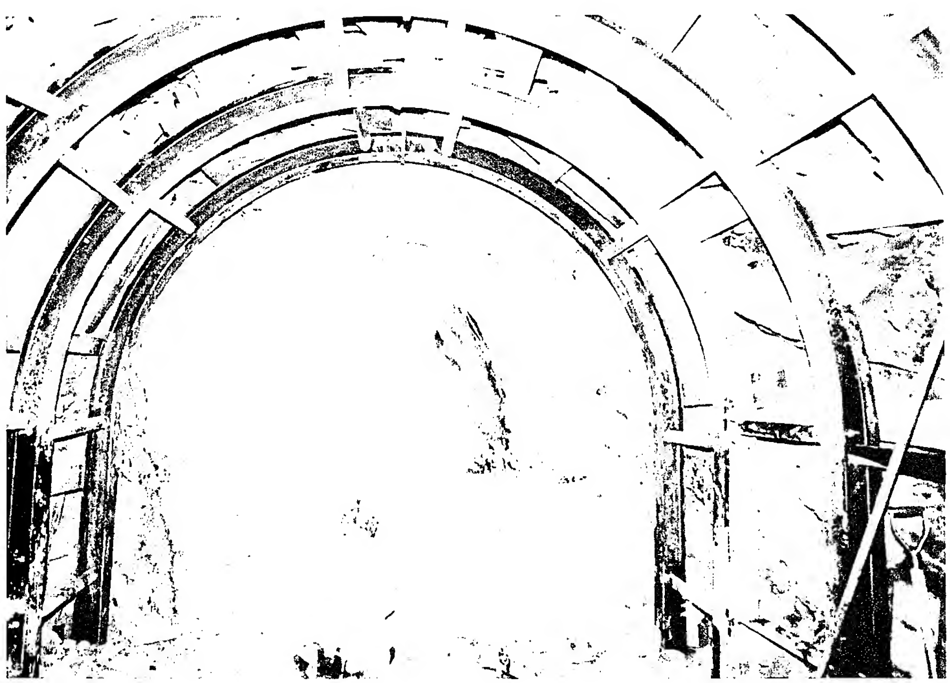
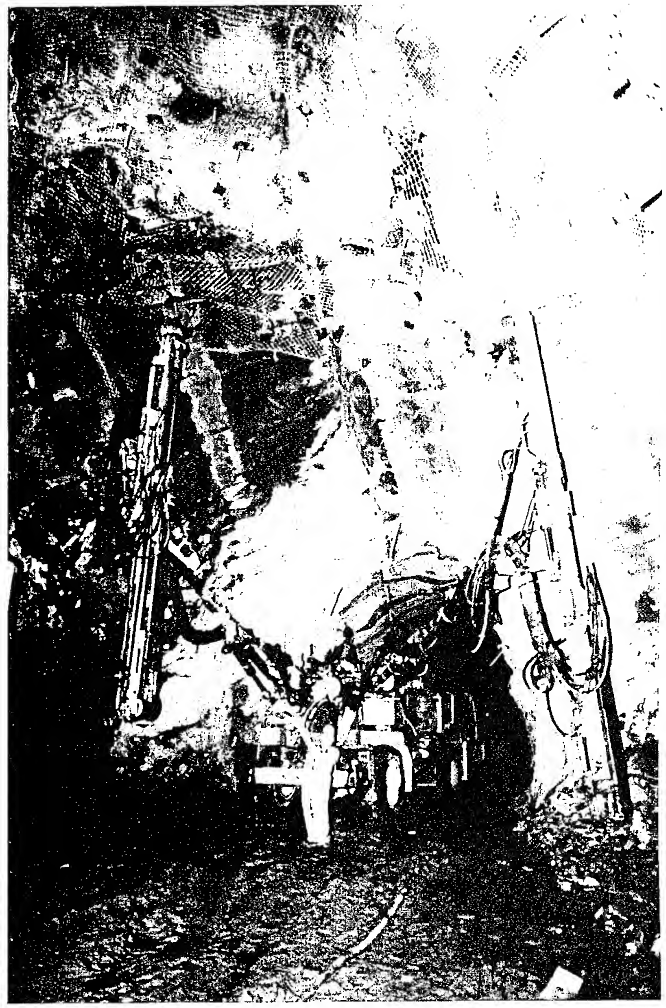


PHOTO T18. Looking upstream at the heading mapped at Sta. 17+89.

PHOTO T19. Looking upstream in the ECC at the two-boom jumbo drilling an anchor hole in row No. 9 in the downstream half of the ECC. The jumbo is sitting in the pilot excavation not yet excavated to the full dimensions of the ECC. Dark squares are anchor plates. Note bedding in crown is subparallel to the tunnel alignment.



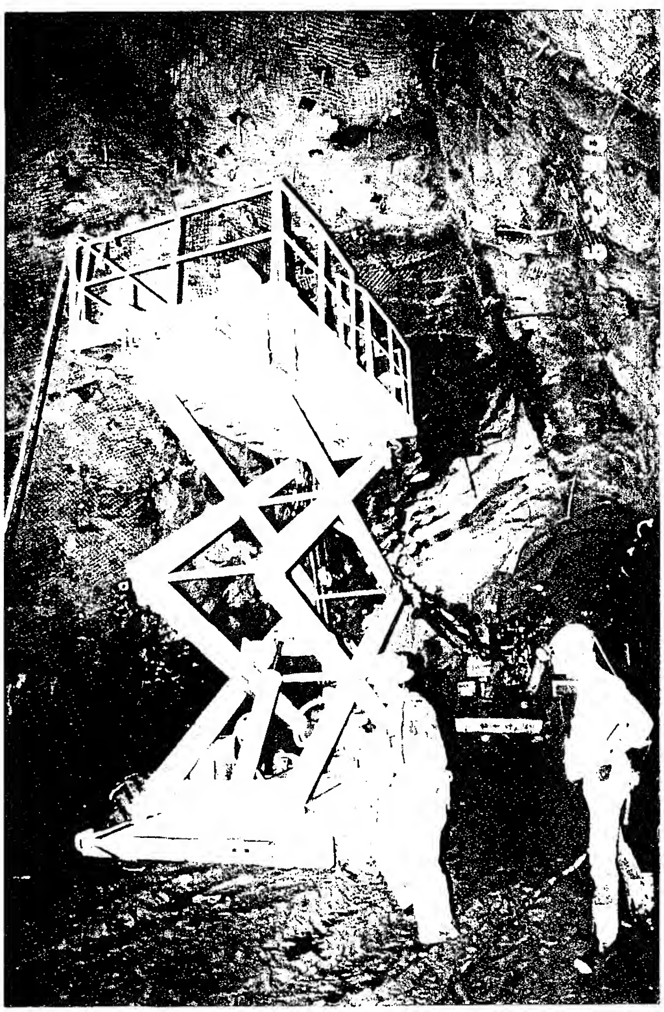


PHOTO T20. Looking upstream at the scissor-lift and jumbo being used to install an anchor bolt in the ECC.

PHOTO T21. Looking right (northwest) at the anchor being installed.

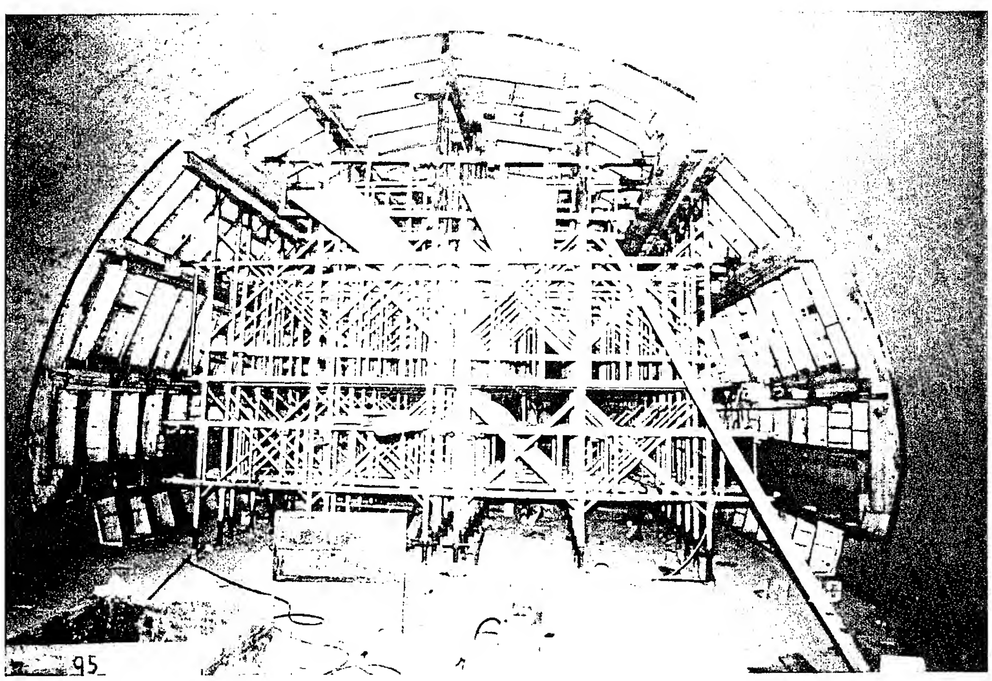


PHOTO T22. Looking upstream at wood form in upstream half of the ECC after placing the concrete lining in the downstream half.

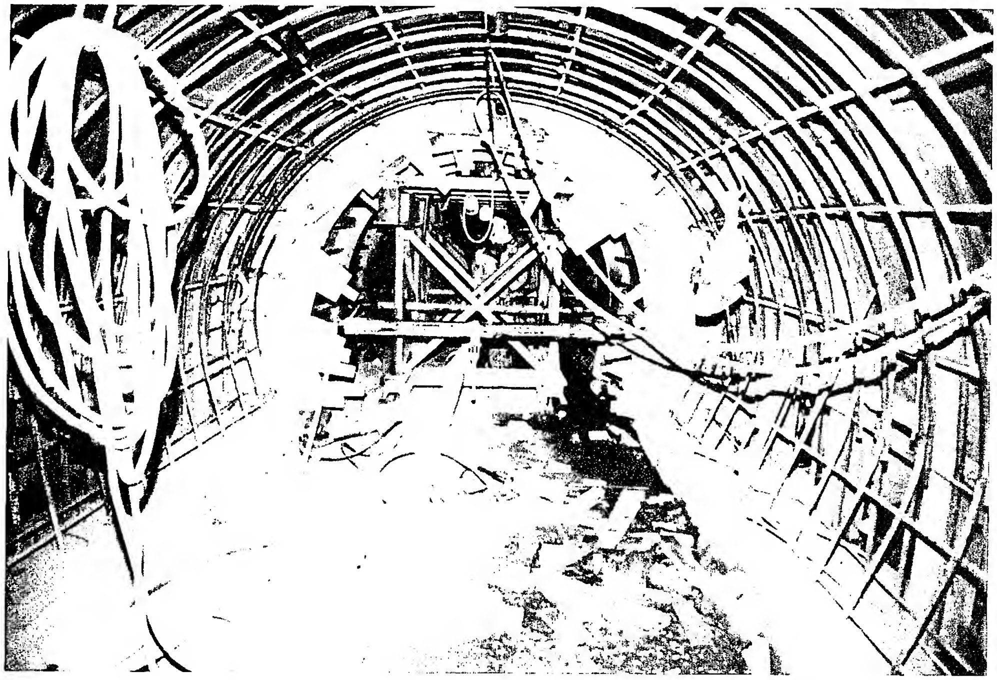


PHOTO T23. Steel slip-form in place, ready to place concrete lining in a portion of the adit.

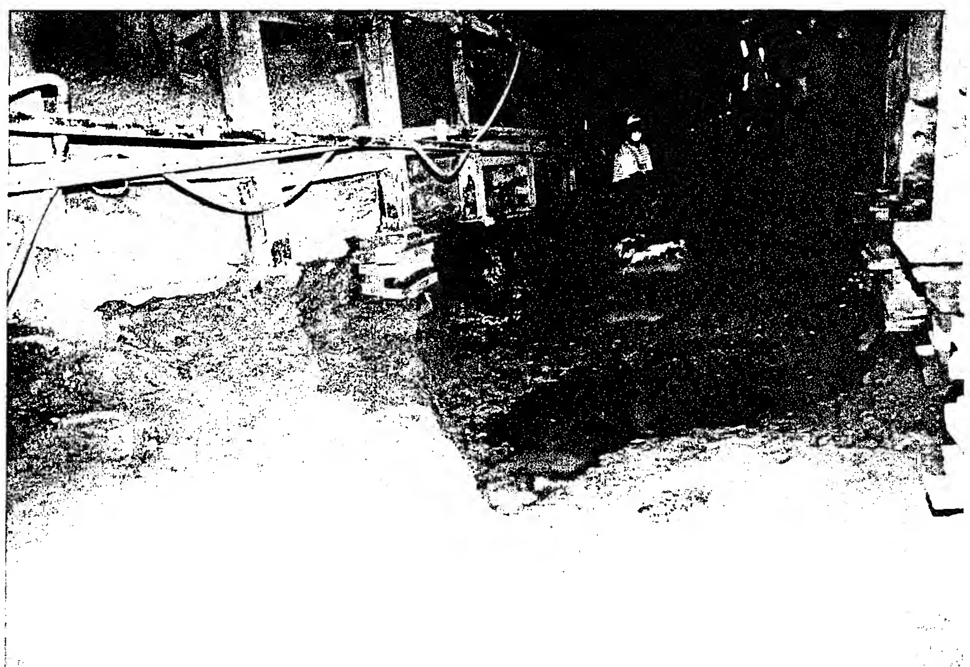


PHOTO T24. Example of where invert was seriously degraded. Note extensive wood blocking under the base of some sets. This resulted when muck was removed in preparation for placing the invert slab.

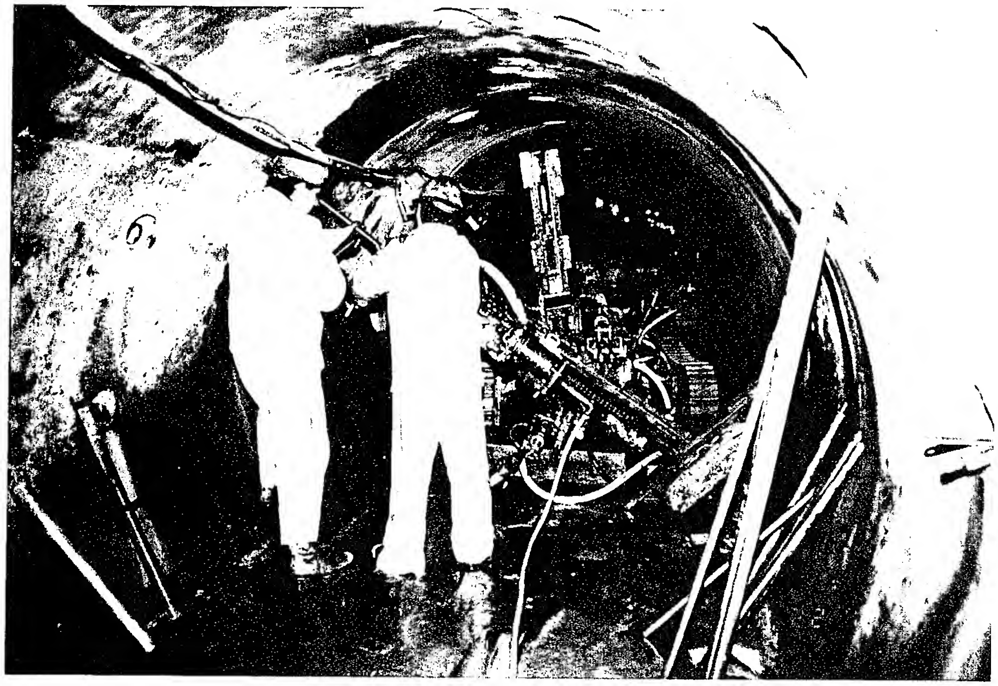


PHOTO T25. Crew drilling grout holes in adit.

PHOTO T26. Grouting in progress in upstream tunnel.

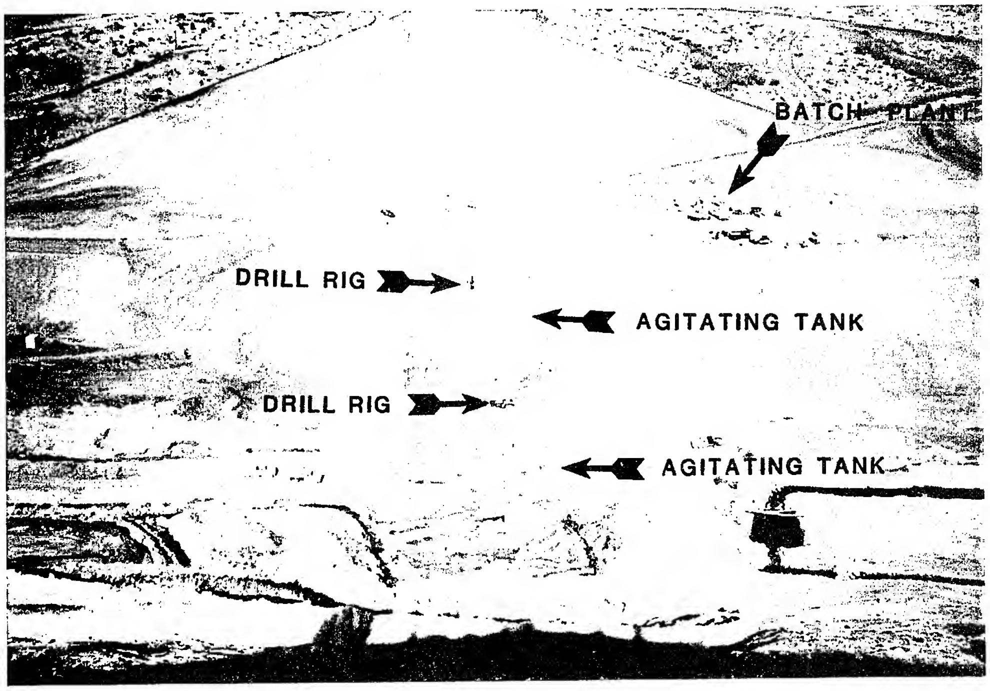


PHOTO GC1 (Grout Curtain 1). Overall curtain grouting operation viewed from the top of the left abutment

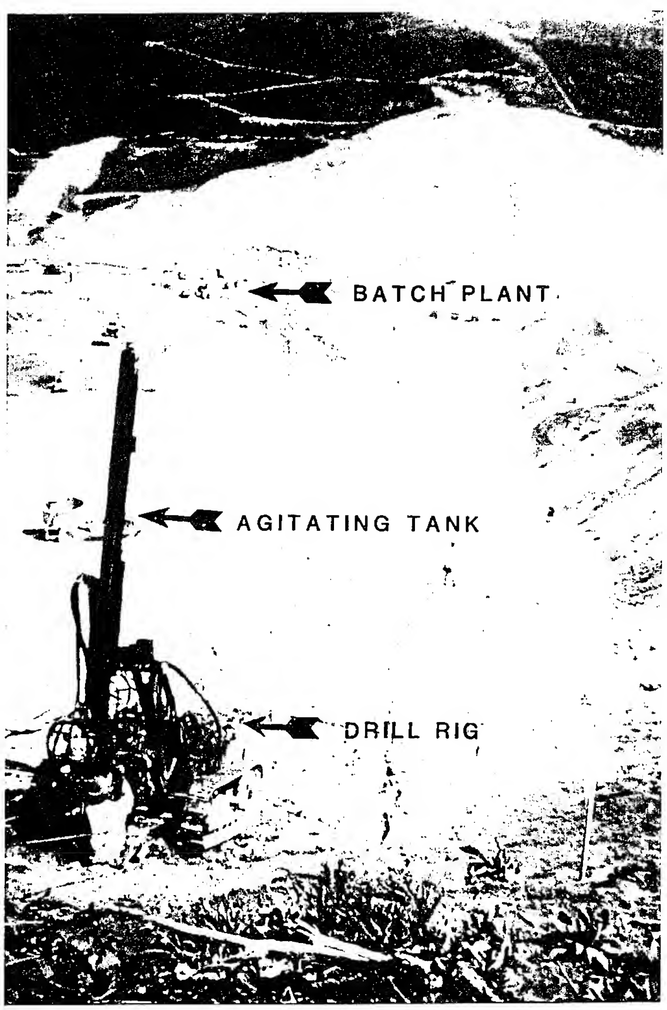


PHOTO GC2. Overall curtain grouting operation viewed from the top of the right abutment.

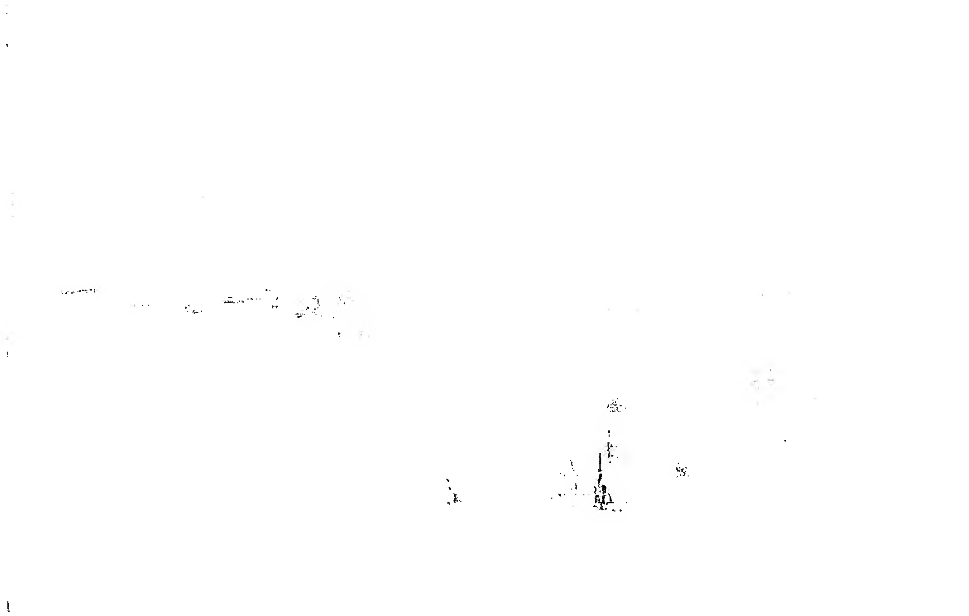


PHOTO GC3. View from the right abutment during the winter of 1989. Grouting continued through the winter except for several days when the temperature was lower than 20 degrees below zero Fahrenheit.

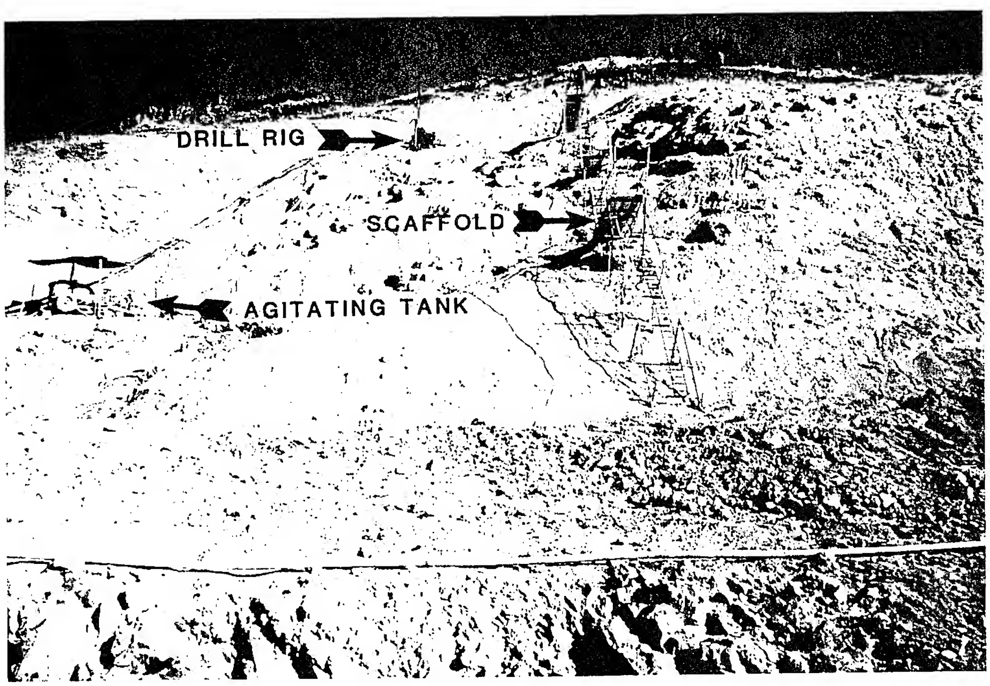


PHOTO GC4. Looking up from the base of the left abutment at the grouting operation.

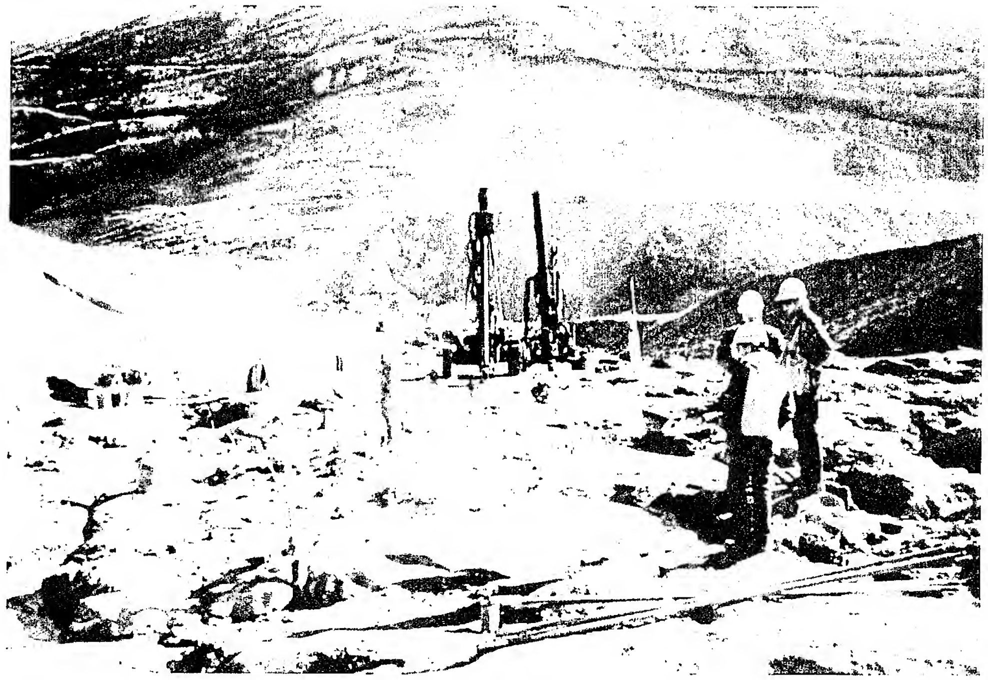


PHOTO GC5. Inspecting the foundation grouting. Looking left at about Sta. 21+00.

PHOTO GC6. Inspecting the foundation grouting. Looking right at about Sta. 16+30.

PHOTO GF1 (Geologic Feature). Left Abutment Fault as seen in a trench logged as 4F-20. The fault is at Station 12+72.5, 150 feet upstream of the dam axis. (See Plates 12 and 19)

PHOTO GF2. View of the upper part of the south wall of fault trench FT-3. Gray sheared bedrock overhangs Older Alluvium.

PHOTO GF3. Shear logged in 4F-19.

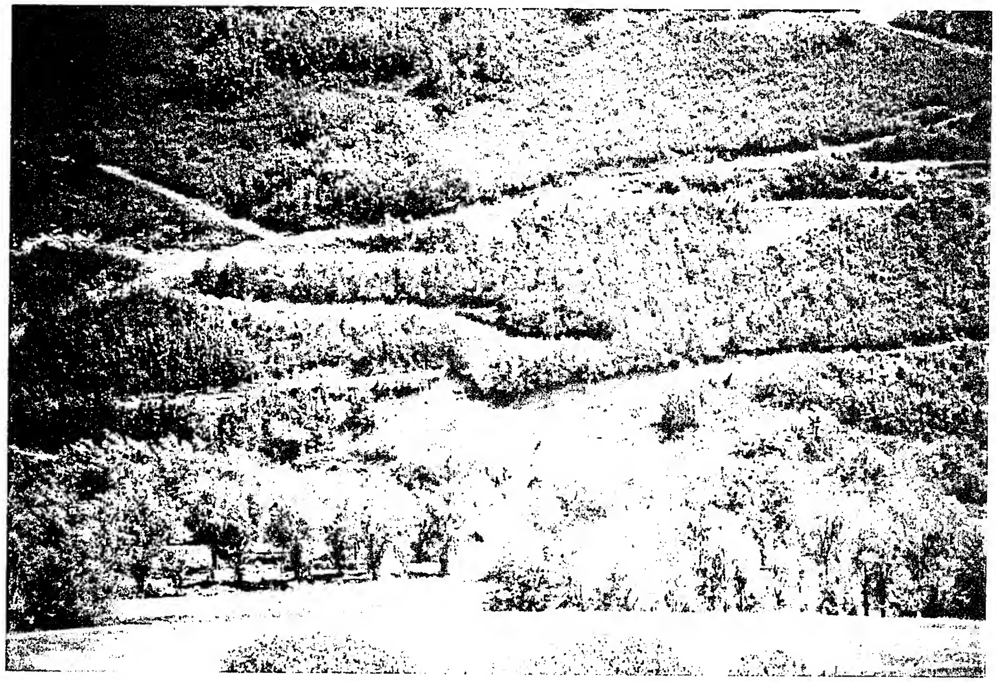


PHOTO P1 (Portals). View of the upstream portal area before beginning the excavation. Photo taken from Highway 65 with telephoto lens.

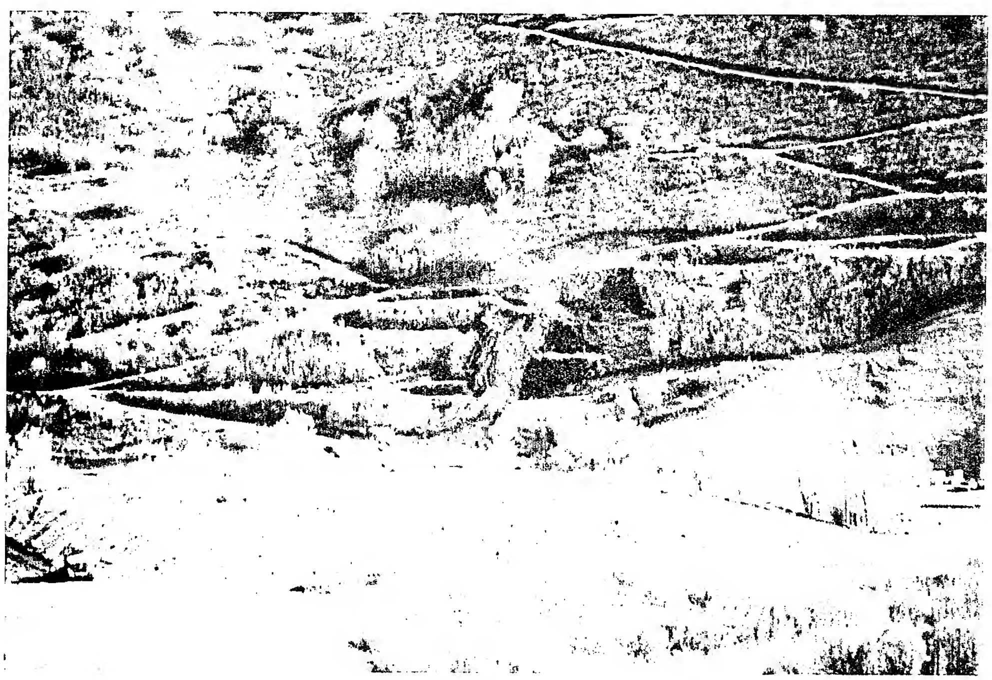


PHOTO P2. Upstream portal shortly after beginning the excavation.

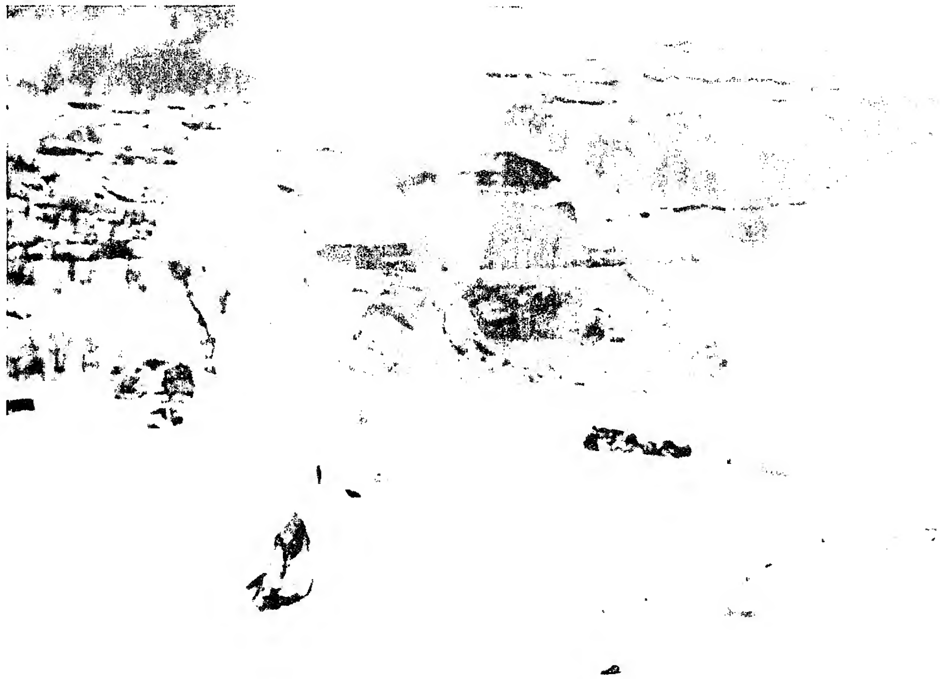


PHOTO P3. Upstream portal on 2/14/90.

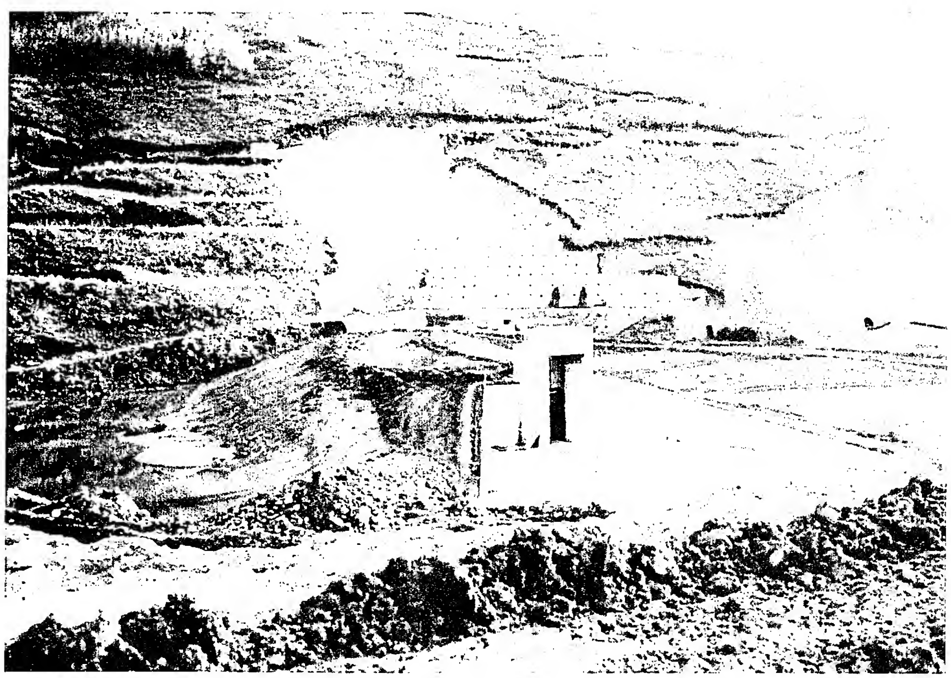


PHOTO P4. Upstream portal area after completion.

PHOTO P5. Looking downstream and left at the downstream portal, before clearing and excavating a bench for installation of the first two inclinometers.

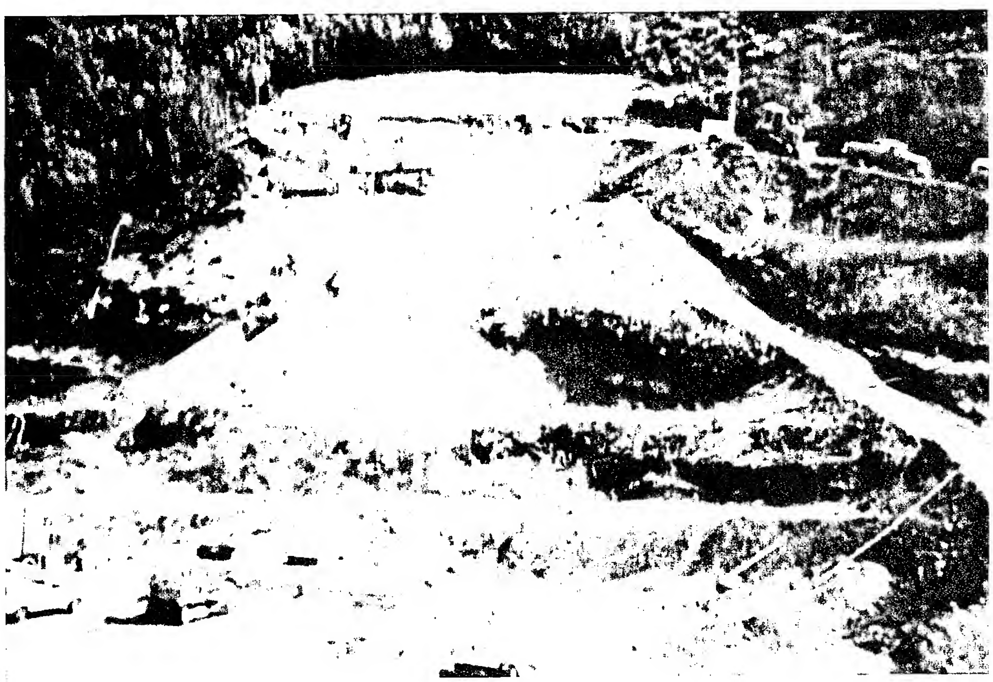


PHOTO P6. Downstream portal on 10/5/89

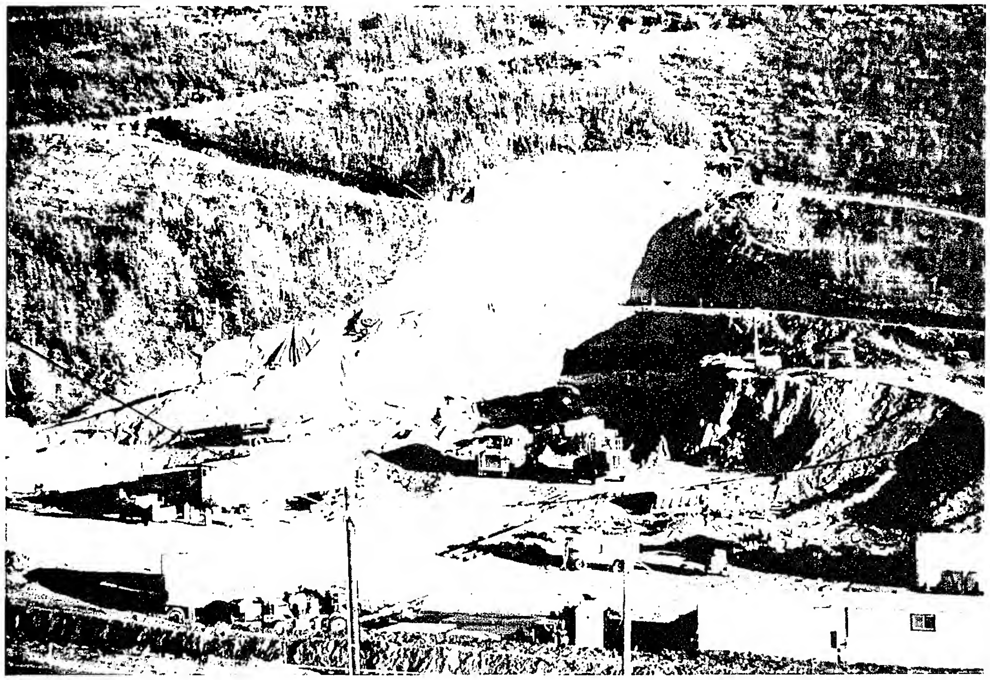


PHOTO P7. Downstream portal on 11/19/89.

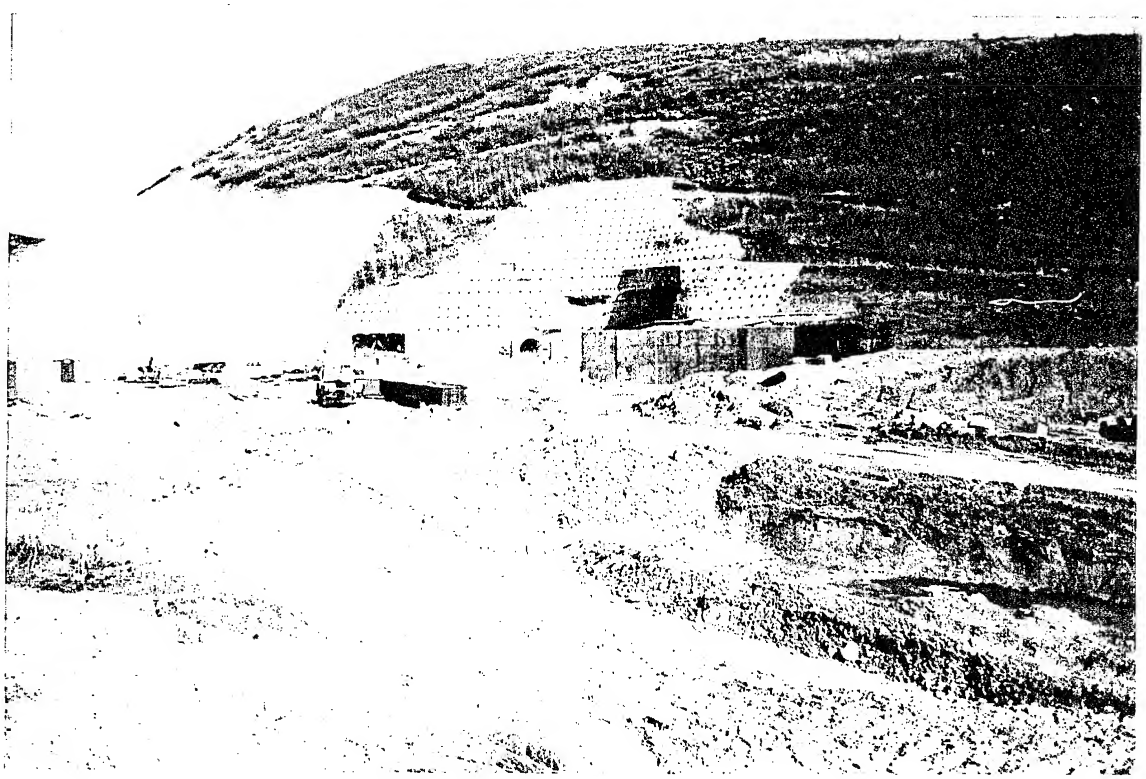


PHOTO P8. Downstream portal after completion of excavation and support and before construction of the DOCS.

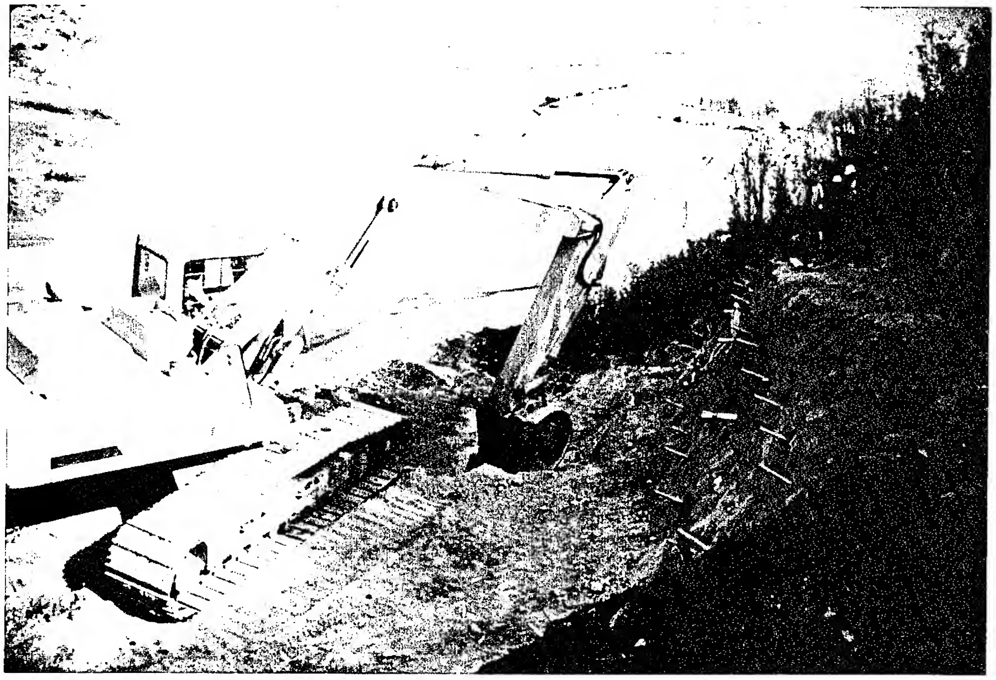


PHOTO P9. Hitachi trackhoe excavating a bench at the downstream portal.

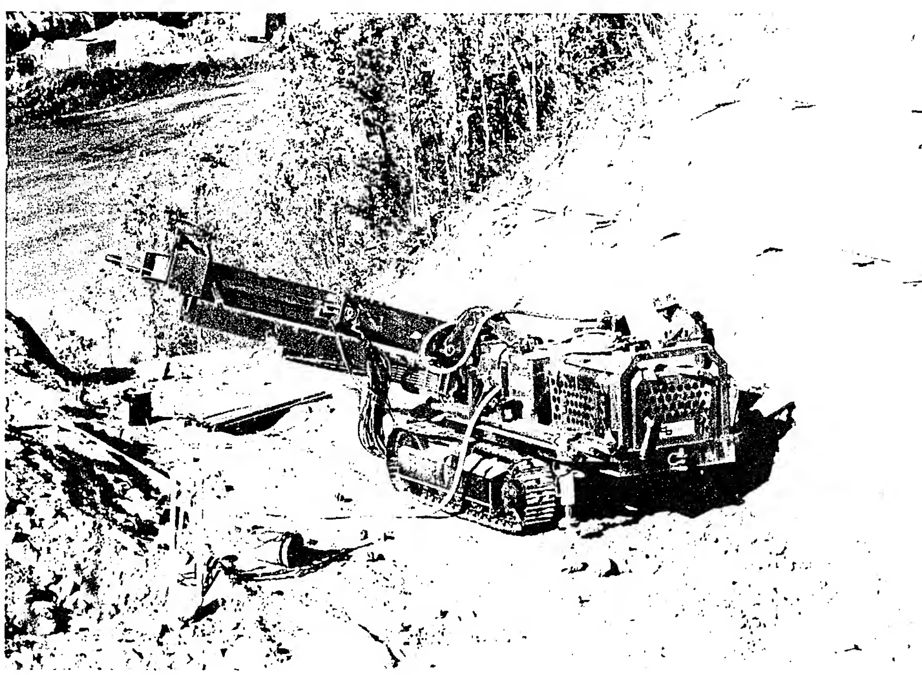


PHOTO P10. Craelius rotary drill - drilling an anchor hole near the bottom of a cutslope at the downstream portal.

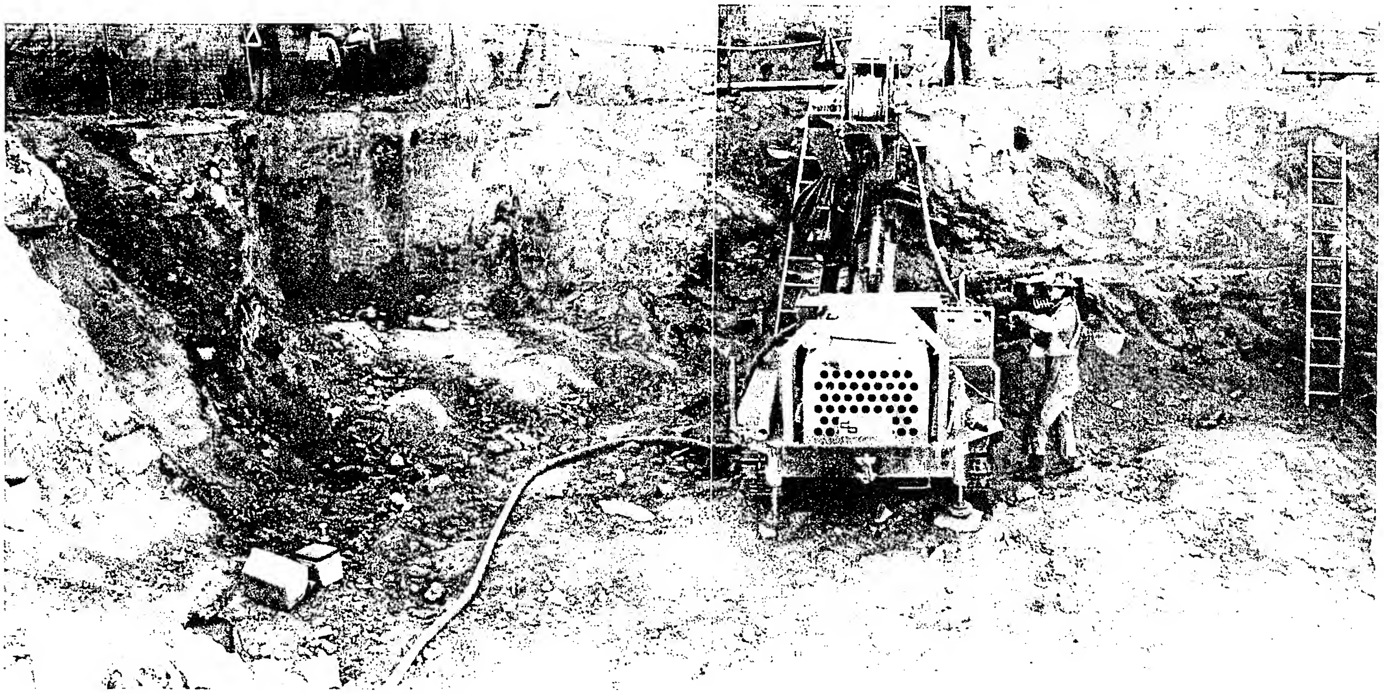


PHOTO P11. Craelius rotary drill - drilling an anchor hole high on the vertical cut at the downstream portal.

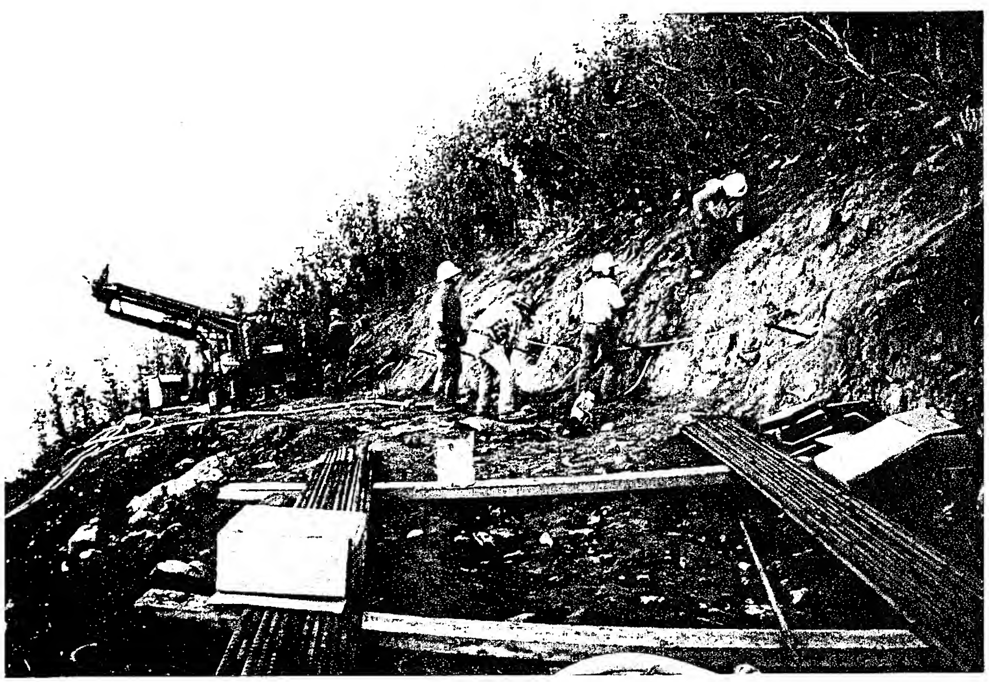


PHOTO P12. Downstream Portal. Crew using an air line to clean anchor holes before installing anchor bars and cement. Anchor bars can be seen in foreground.

PHOTO P13. Taping centralizers to anchor bars before installing them.

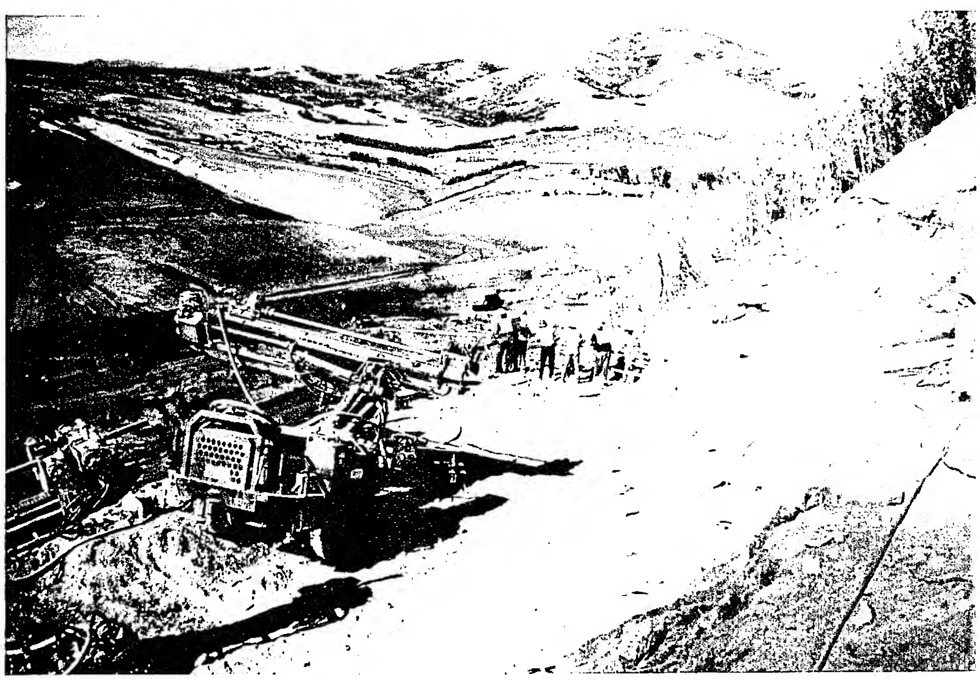


PHOTO P14. Downstream Portal. Installing 2-inch-diameter, slotted PVC for draining the slope. Numerous anchors have been installed in the cut-slope. The bars and the PVC tubes through which the grout was injected are visible.

PHOTO P15. Performing a pull-out test on an anchor installed at the downstream portal.

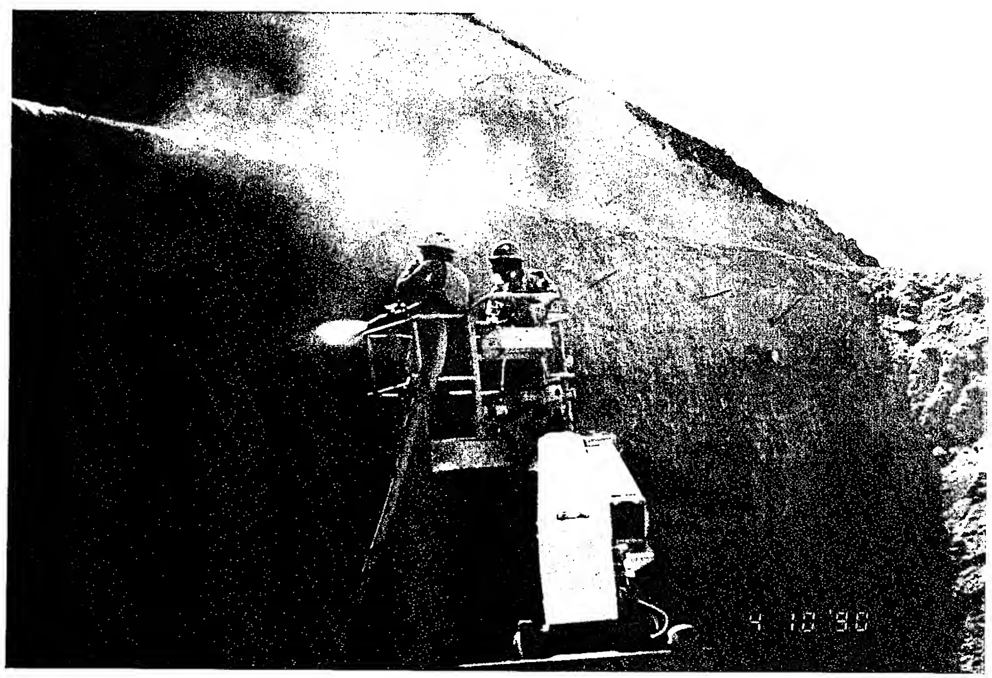


PHOTO P16. Applying shotcrete to vertical cut at upstream portal.

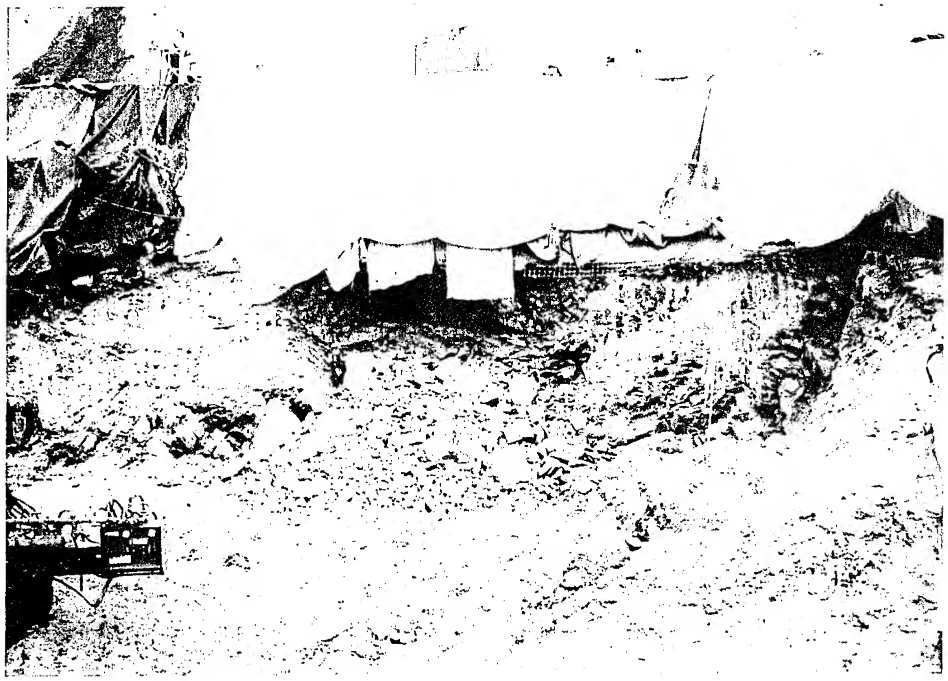


PHOTO P17. Failure of vertical face at downstream portal excavation. Cut failed in a weak, altered bed when a 14+ feet high increment was excavated without support.

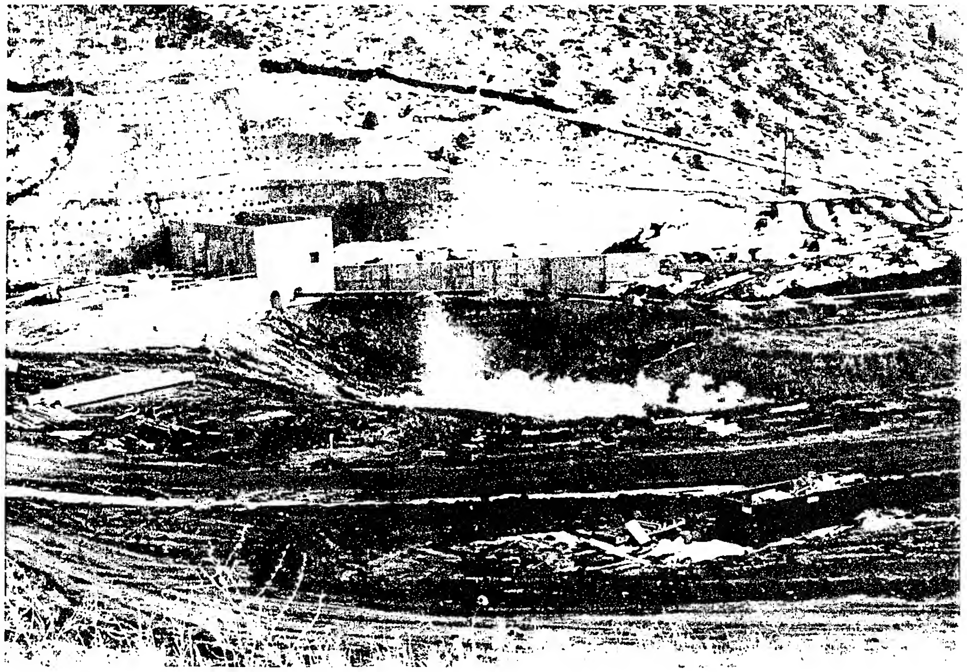


Photo D1 (DOCS). View of the downstream Outlet Works area, looking southeast, as a round is blasted to excavate hard rock in the bottom of the Plunge Pool.

Photo D2. Looking south at the foundation for the downstream half of the DOCS. The foundation consists of firm bedrock of the Kelvin Formation

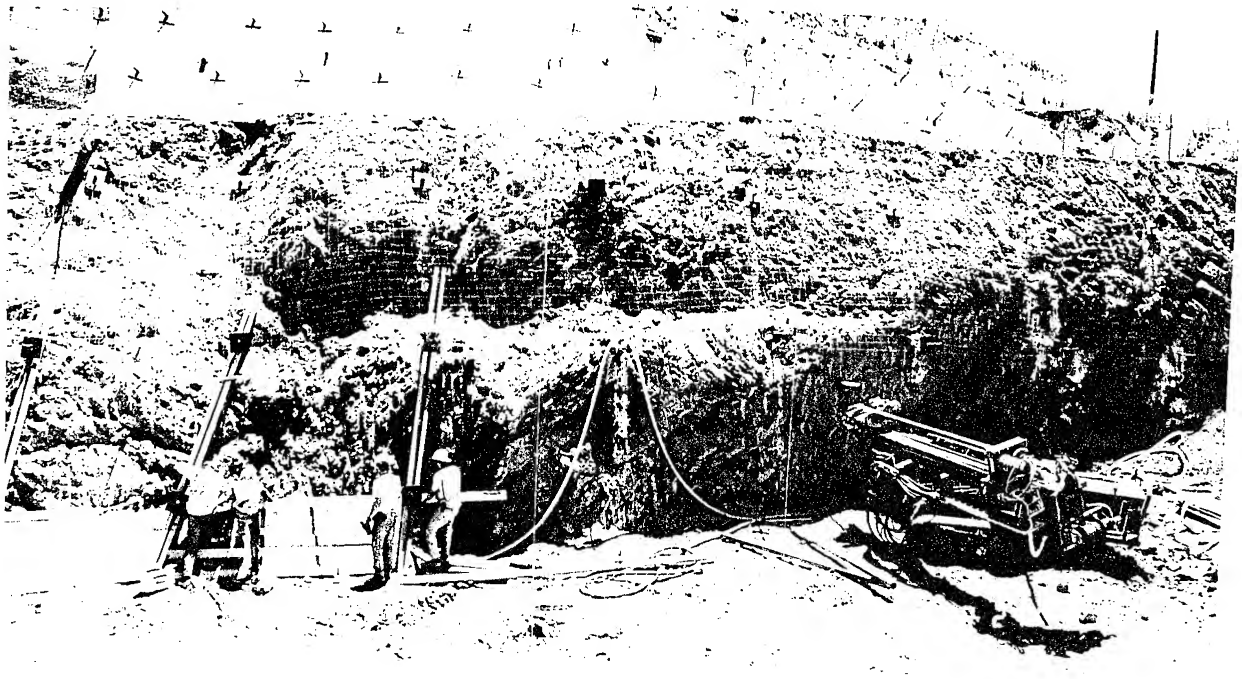


PHOTO D3. Looking south at rock anchors and wood cribbing being installed to support the unstable slope adjacent to the downstream wingwall foundations.

PHOTO D4. Looking south at the foundation for the north wingwall at the DOCS.

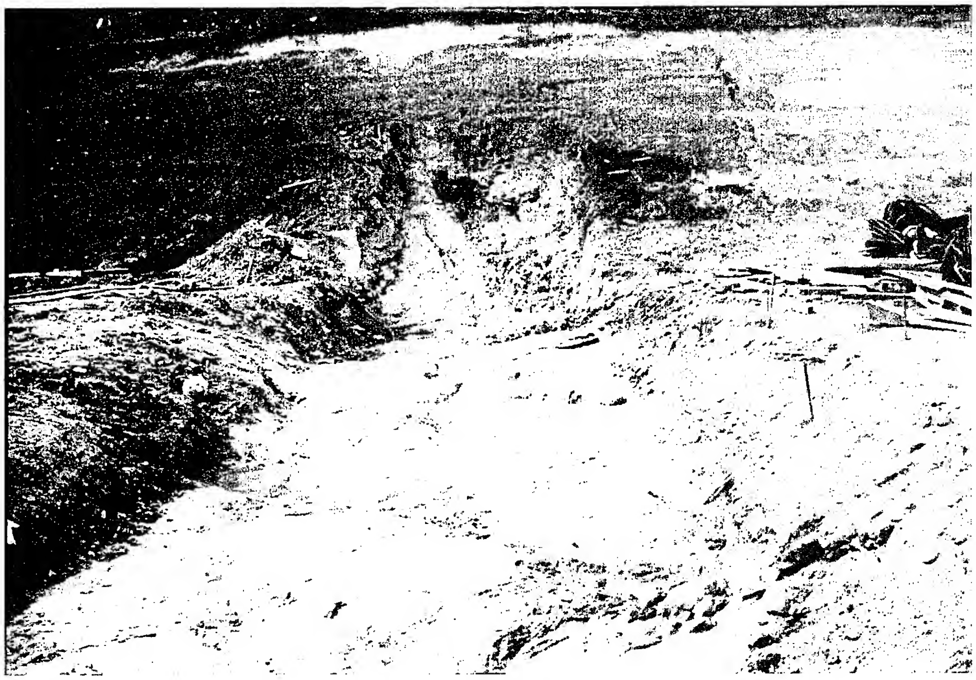


PHOTO S1 (Spillway). Looking right at the foundation for the right half of the spillway sill, from the spillway centerline.

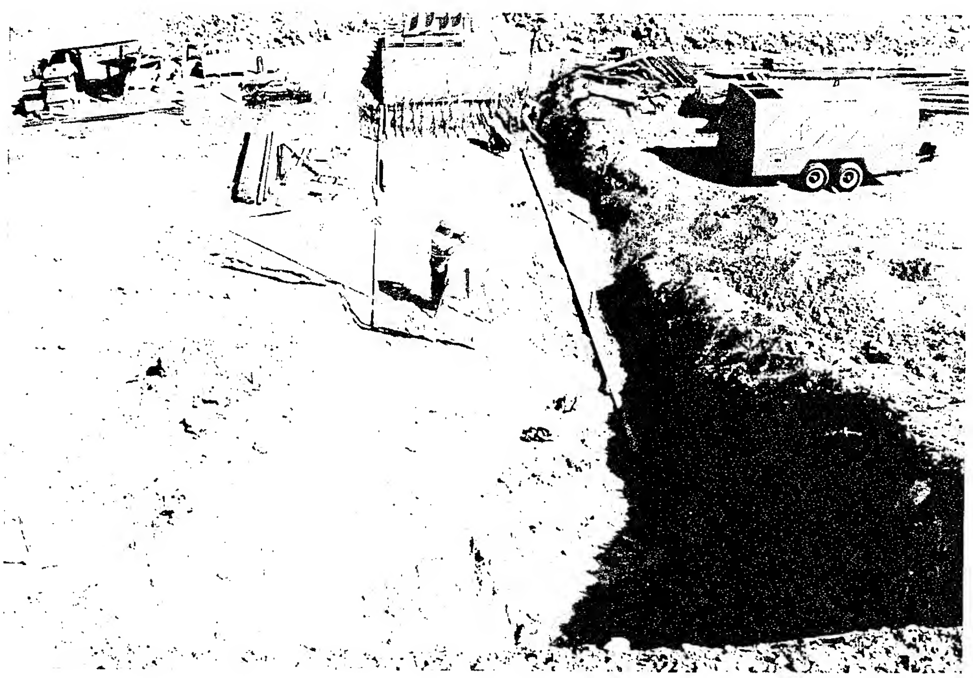


PHOTO S2. Looking right at the foundation for the left half of the spillway sill, from the top of the left cutslope.

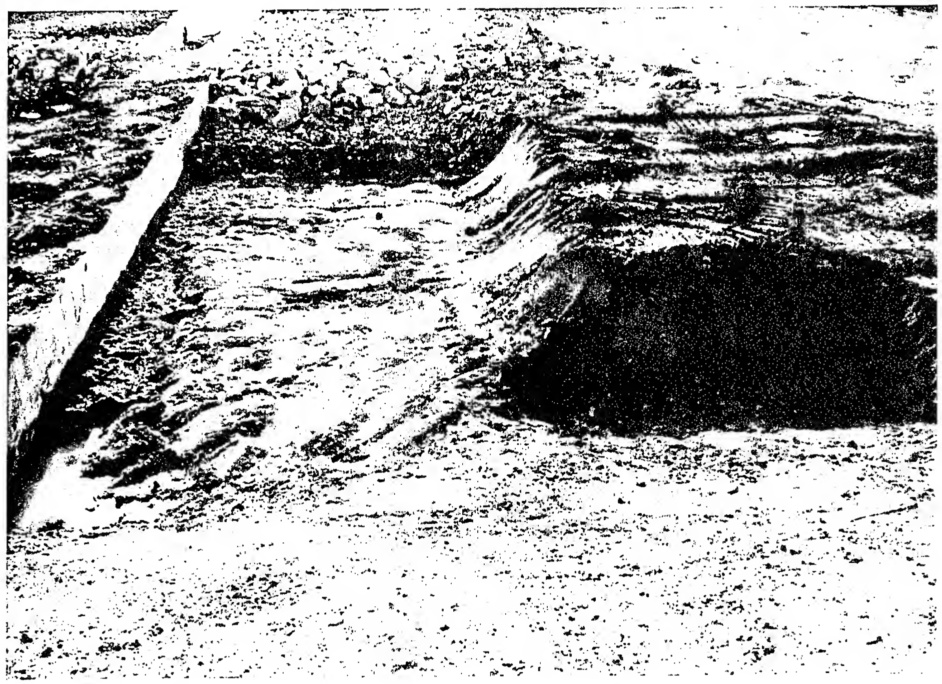


PHOTO S3. Looking left at the foundation for the oversize stone downstream of the right half of the spillway.

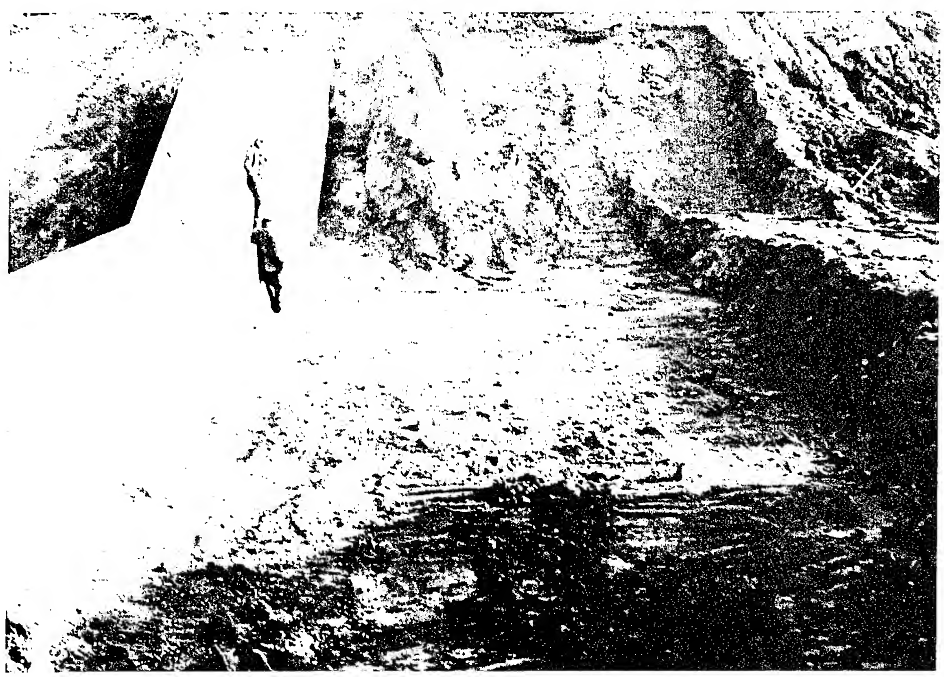


PHOTO S4. Looking left at the foundation for the oversize stone downstream of the left half of the spillway.

PHOTO S5. Looking right at the foundation for the rip rap on the upstream right cutslope of the spillway.

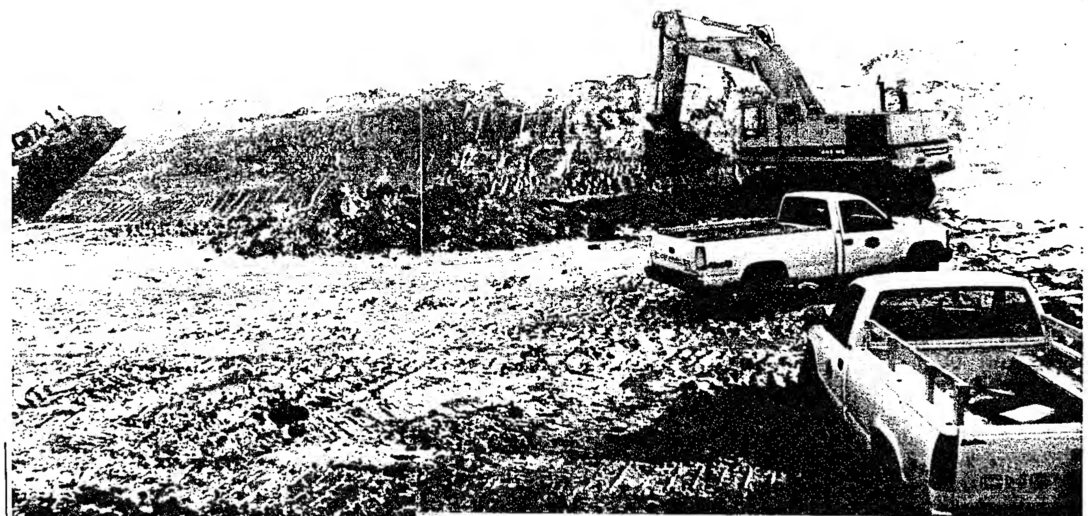


PHOTO S6. Looking left at the foundation for the rip rap on the upstream left cutslope of the spillway.

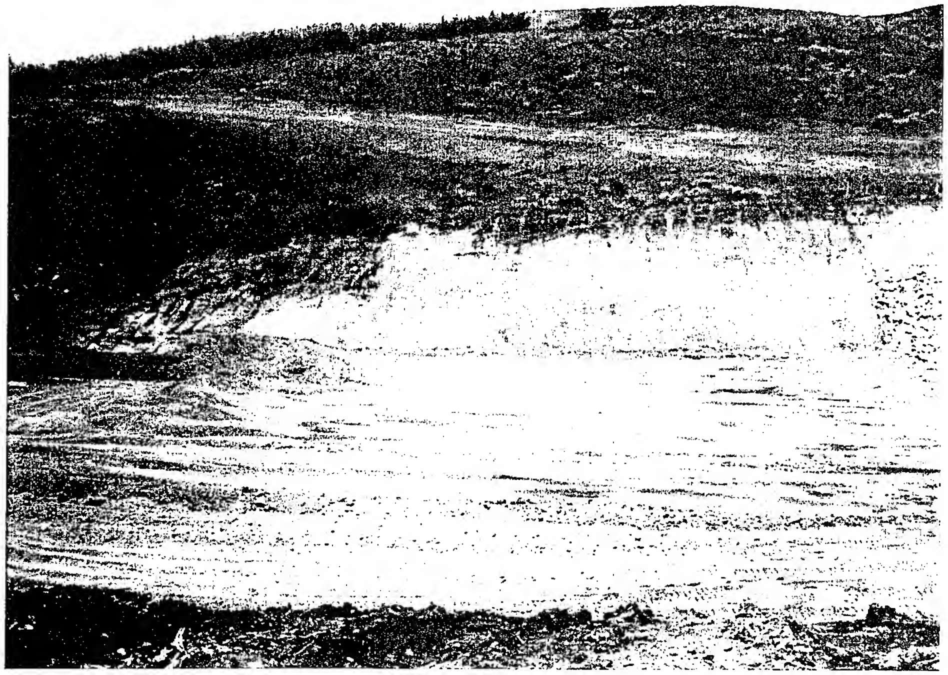


PHOTO S7. Looking at the right cutslope, downstream of the spillway sill.

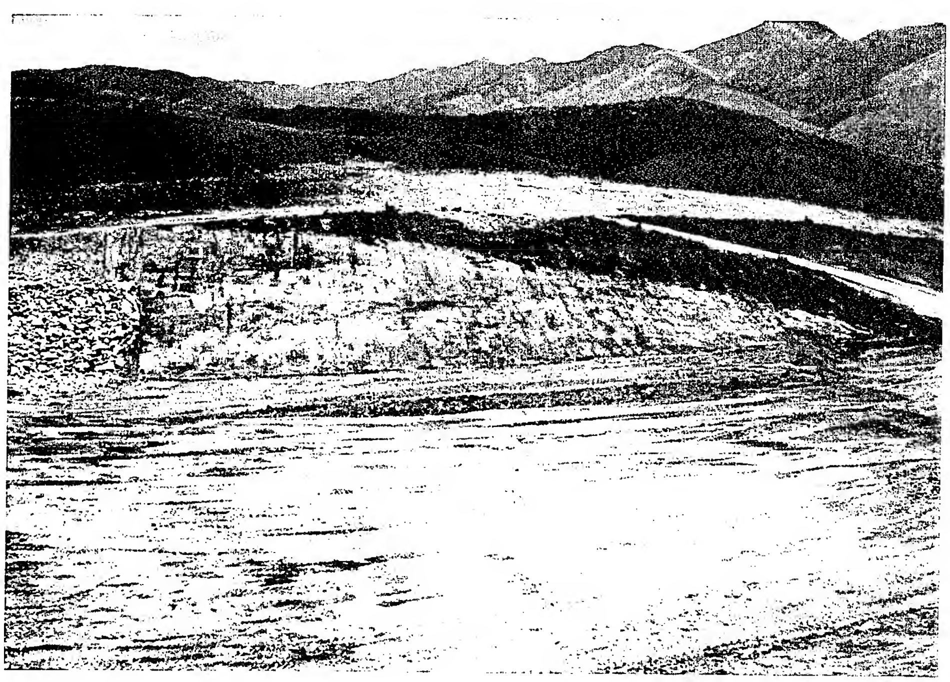


PHOTO S8. Looking at the left cutslope, downstream of the spillway sill.

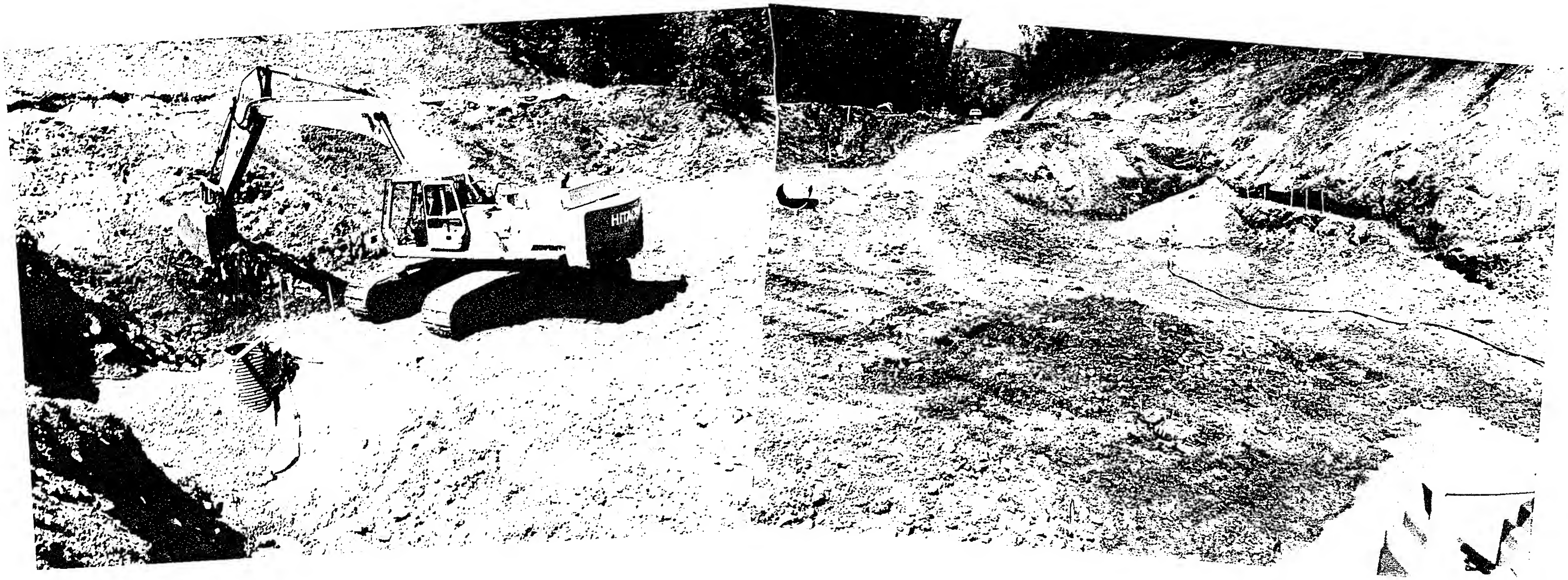


PHOTO PC1 (Parley's Creek Diversion Structure). Looking downstream from the upstream end of the Diversion Structure foundation. The Hitachi trackhoe is doing final excavation before placing fill at the spillway. The right half of the foundation requires additional excavation.

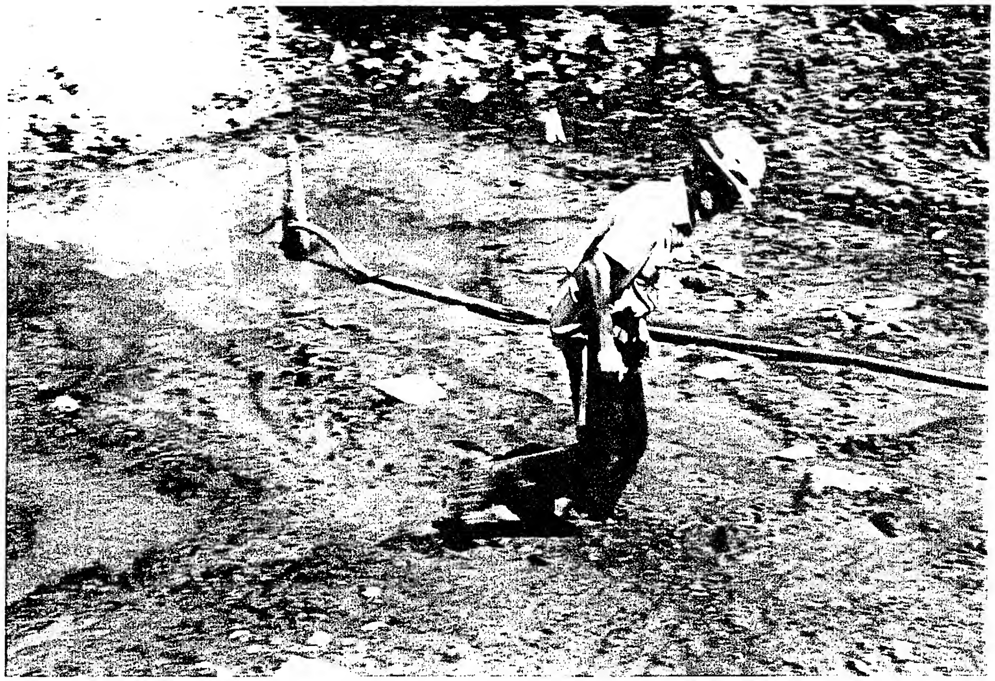


PHOTO PC2. Foundation of the downstream right half of the structure continued to deteriorate until all the alluvium was removed, in part because the Contractor could not control ground water.

PHOTO PC3. All the loose material was excavated from the area in the previous photo and firm bedrock of the Kelvin Formation was exposed.

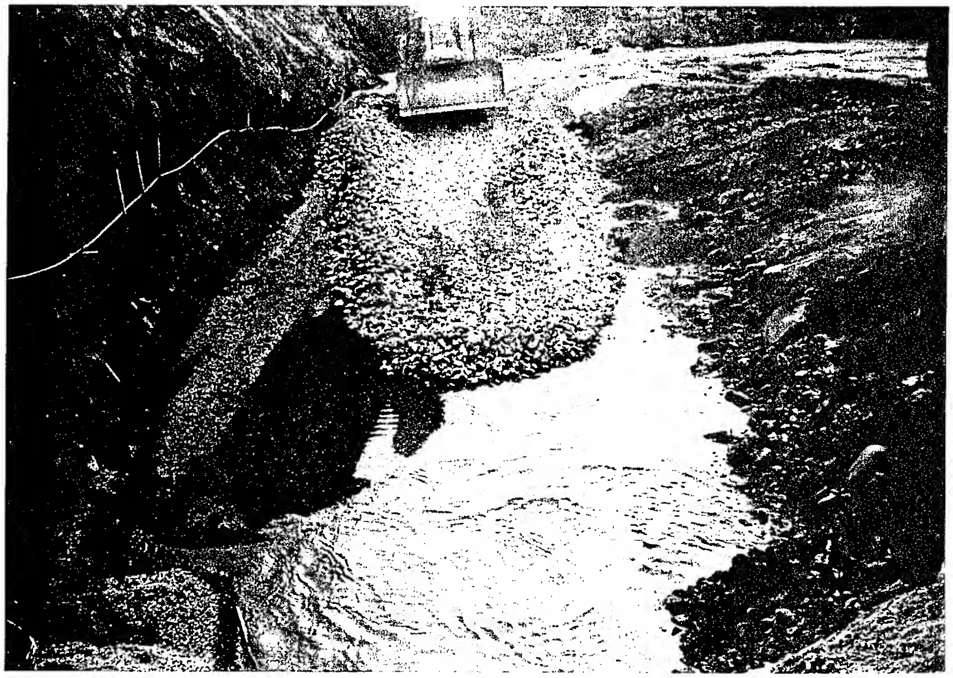


PHOTO PC4. After overexcavating to remove the soft, saturated alluvium, the foundation was brought back up to grade with angular gravel and cobbles.

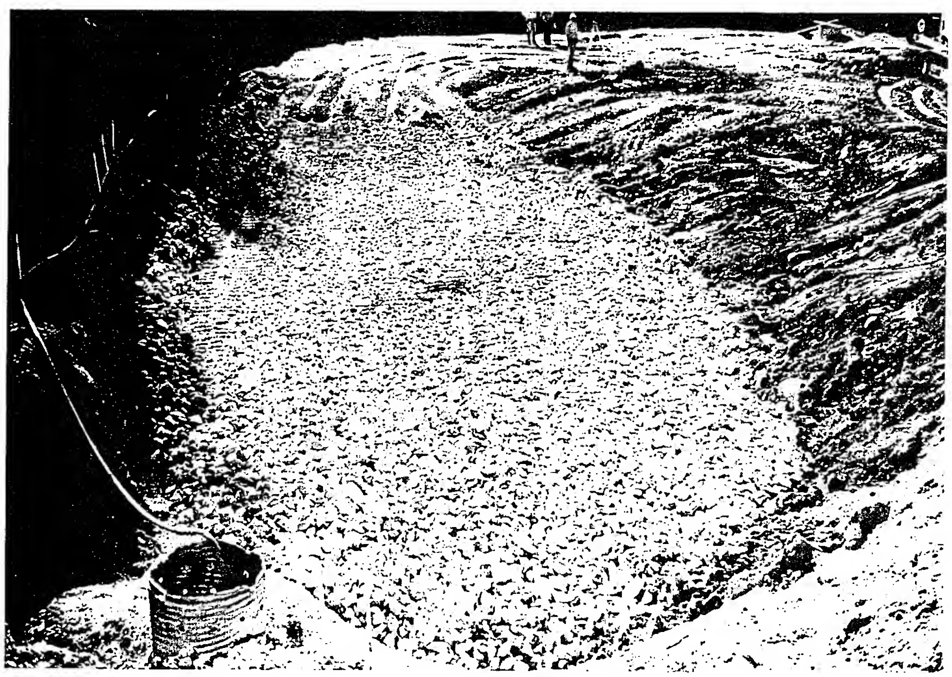


PHOTO PC5. The foundation at the downstream right corner of the diversion structure as approved.

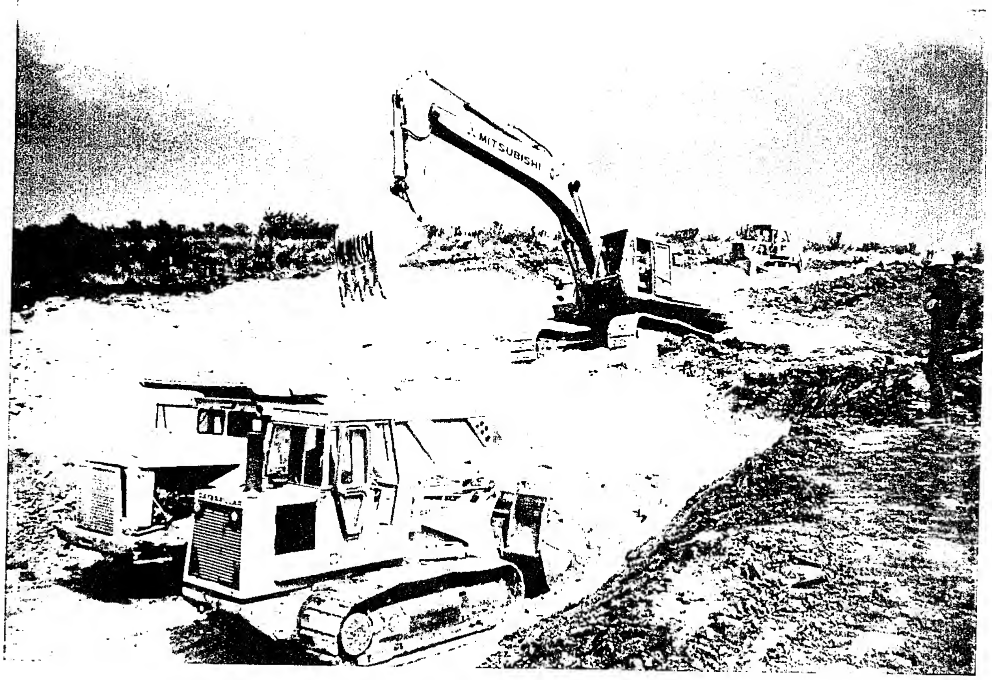


PHOTO E1 (Equipment 1). Dozer, track hoe, front end loader and dump truck excavating at the upper right abutment during the core trench contract.

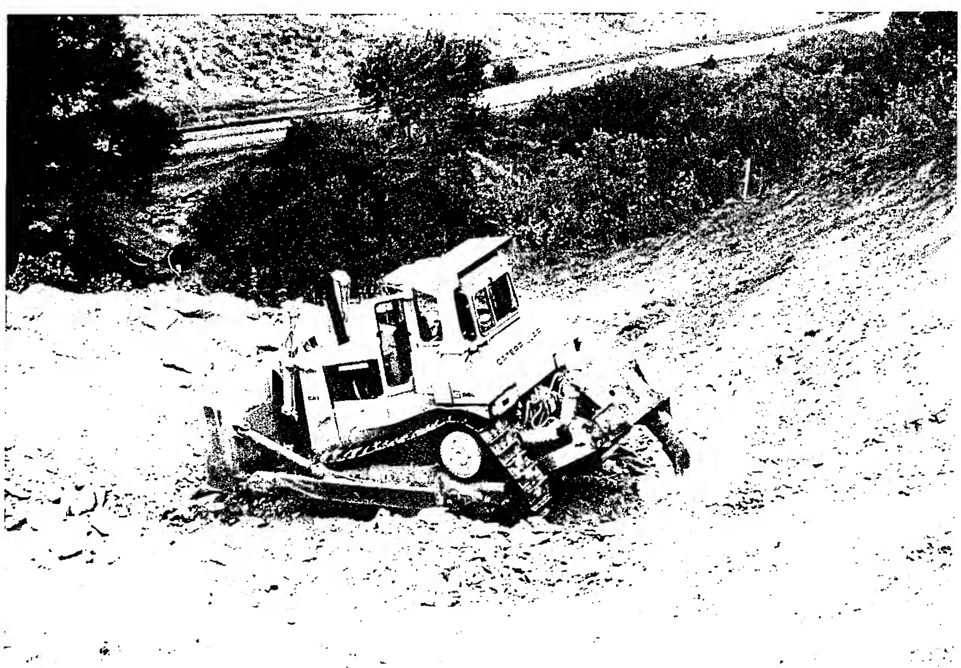


PHOTO E2. D-8 dozer attempting to rip hard rock on left abutment.

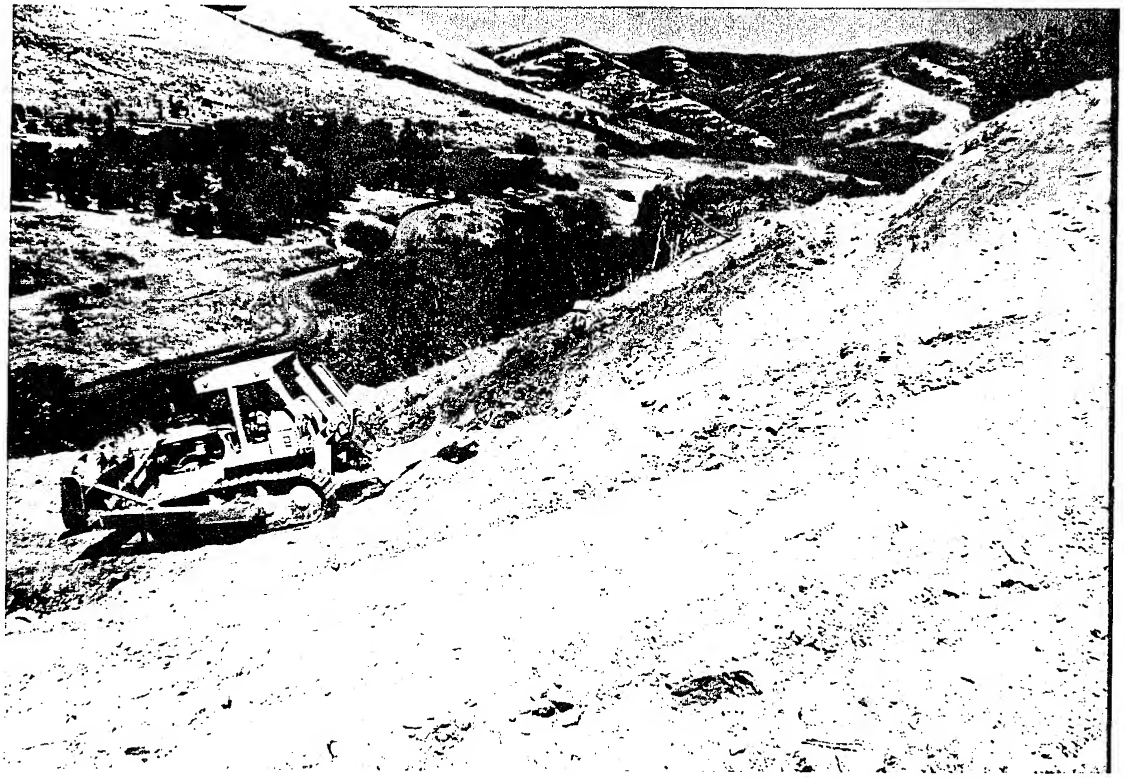


PHOTO E3. D-8 Dozer ripping soft rock on left abutment.

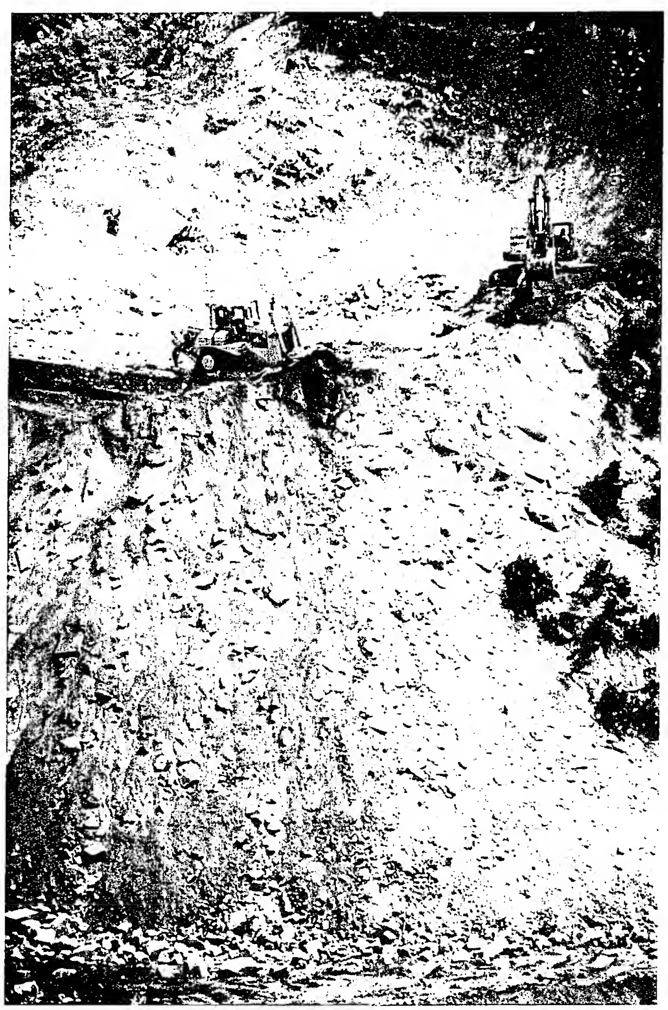


PHOTO E4. Cat D-8 dozer and Cat 235 backhoe working together at left abutment. Trackhoe casts material to edge of bench after dozer rips.

PHOTO E5. Load-haul-dump (LHD), mucking machine, parked at D/S portal.

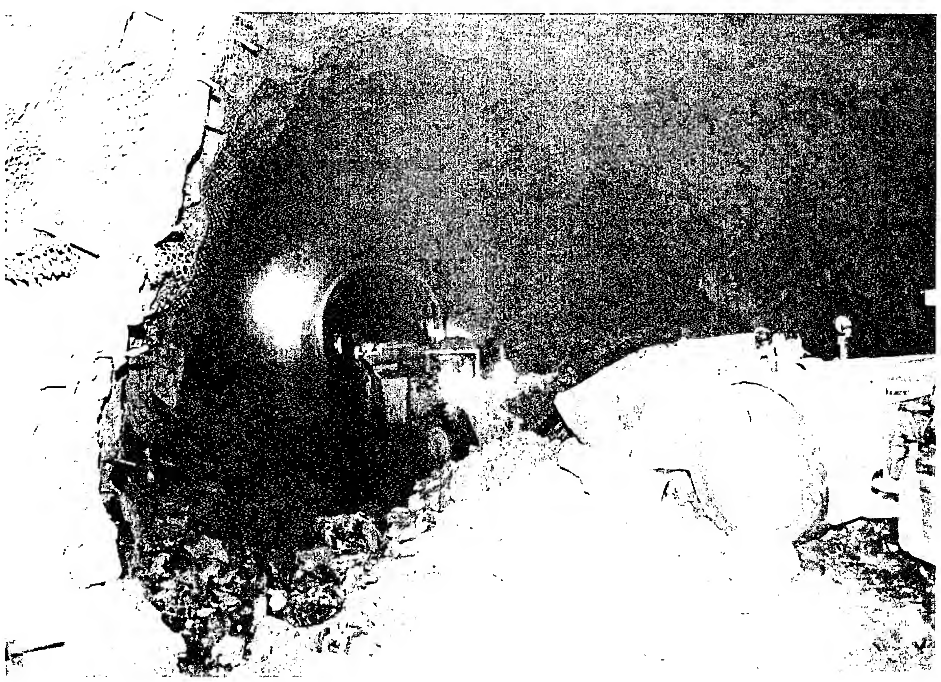


PHOTO E6. Two LHD mucking machines removing blasted material from ECC.

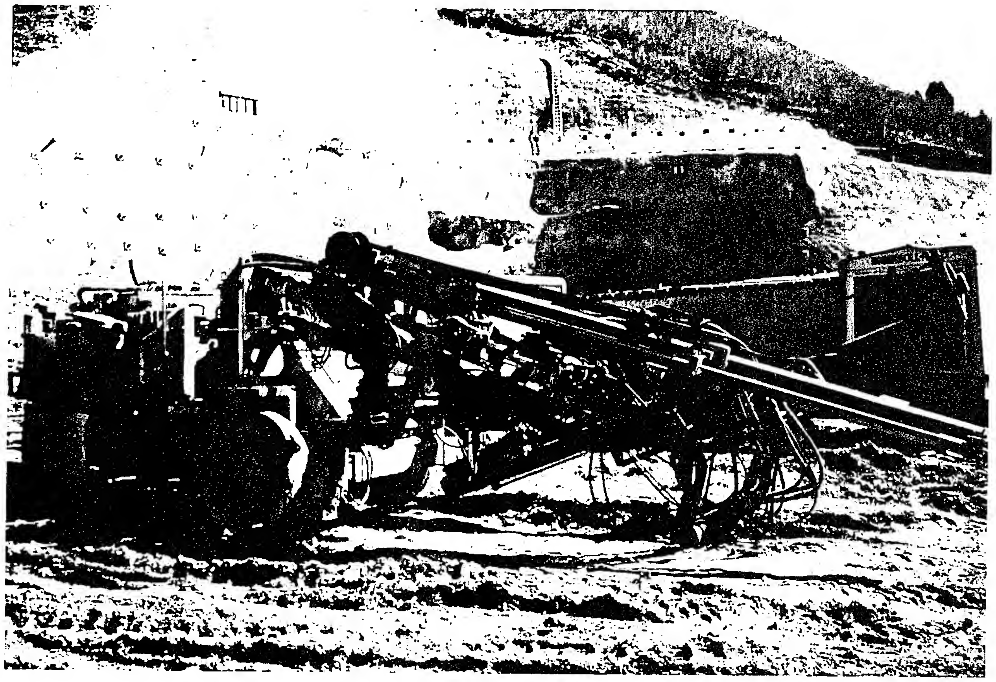


PHOTO E7. Two-boom drill jumbo parked at downstream portal.

PHOTO E8. Drill jumbo drilling two blast holes at once, using both booms, in crown of ECC.

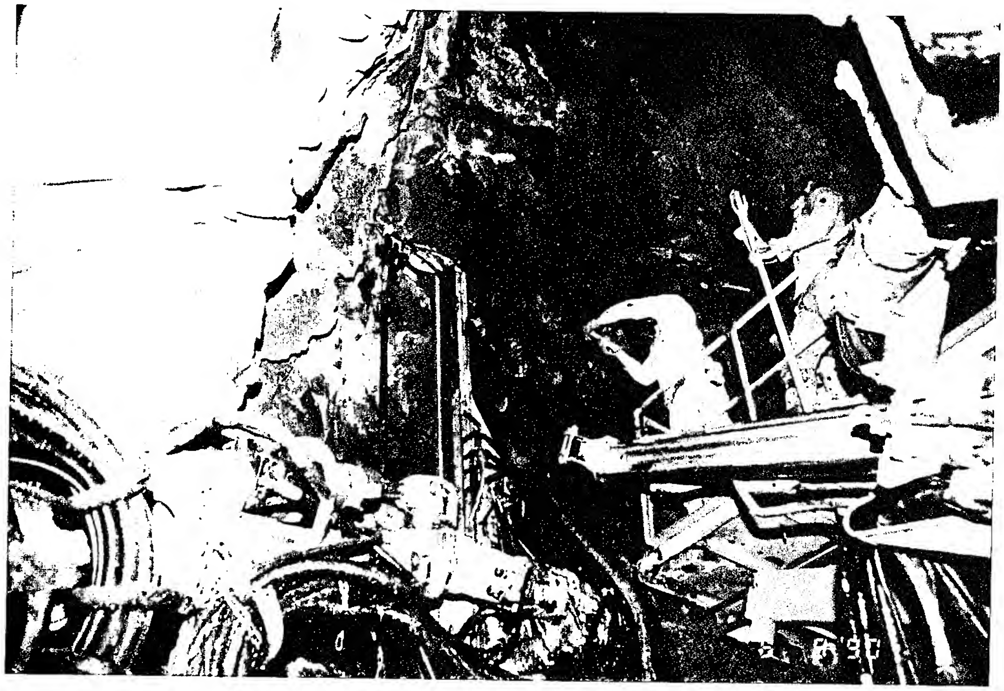


PHOTO E9. Miners loading two part resin grout (celtile) in ECC anchor hole.

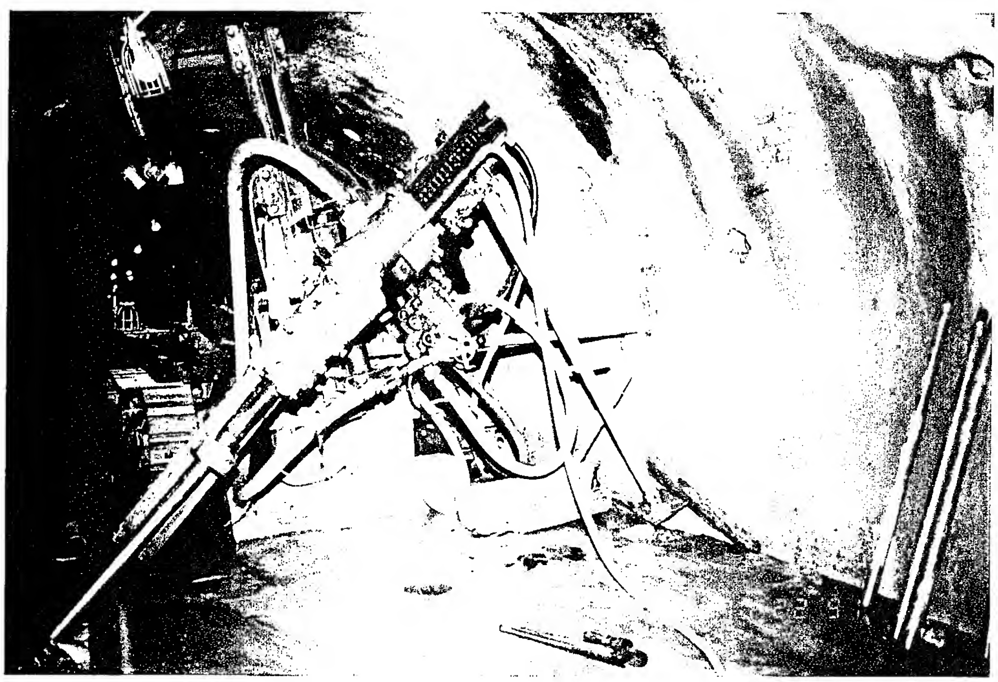


PHOTO E10. Track mounted rotary drill drilling tunnel grout holes.

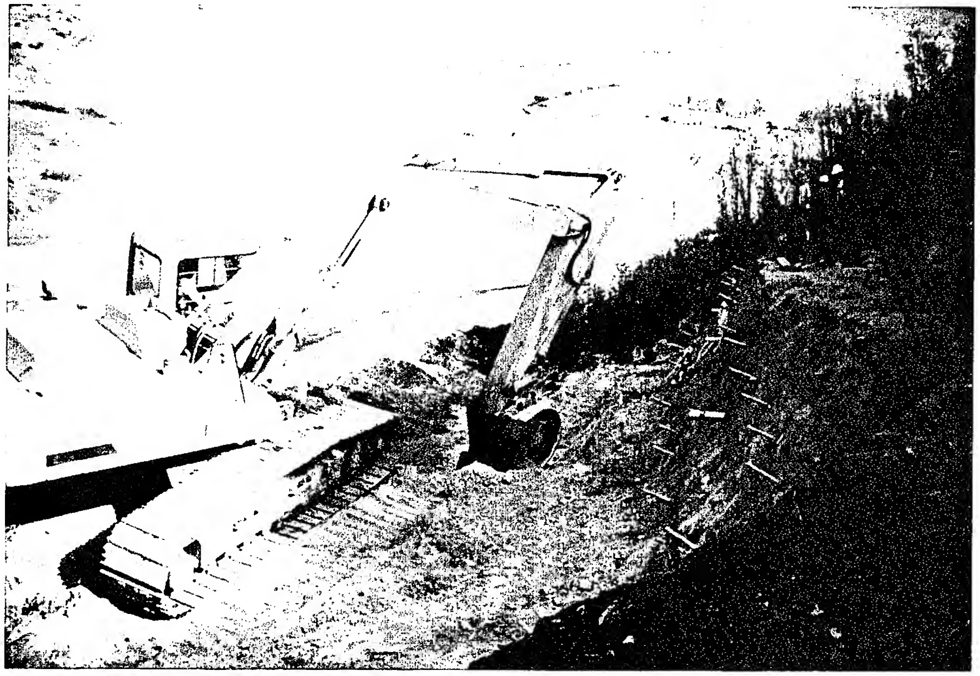


PHOTO E11. Hitachi EX270 LC excavating downstream portal.

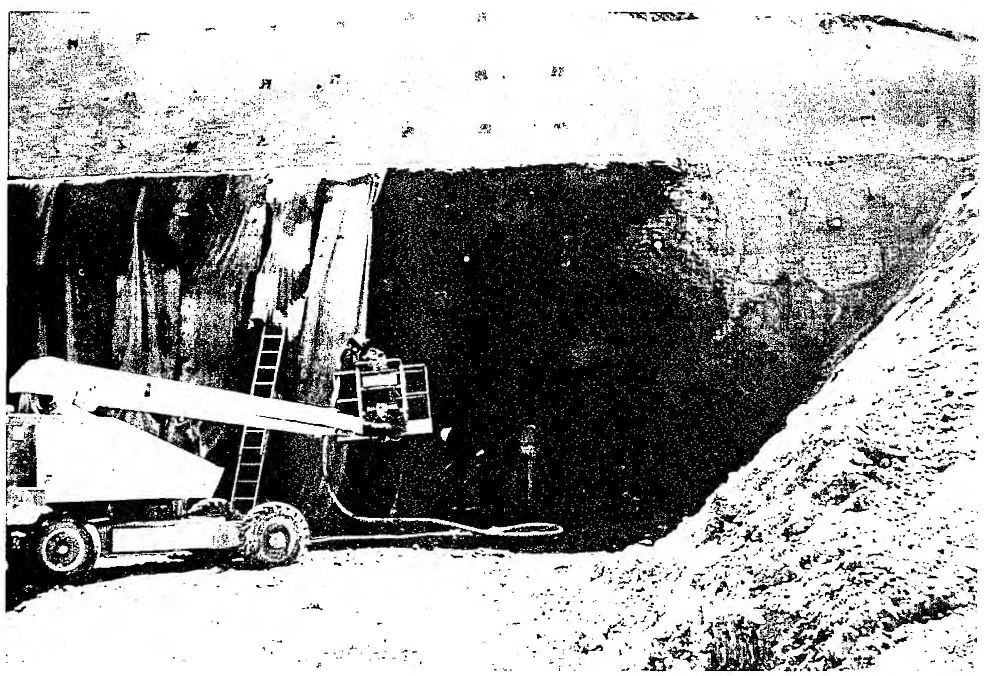


PHOTO E12. "Snorklift" manlift used for applying shotcrete to portals.

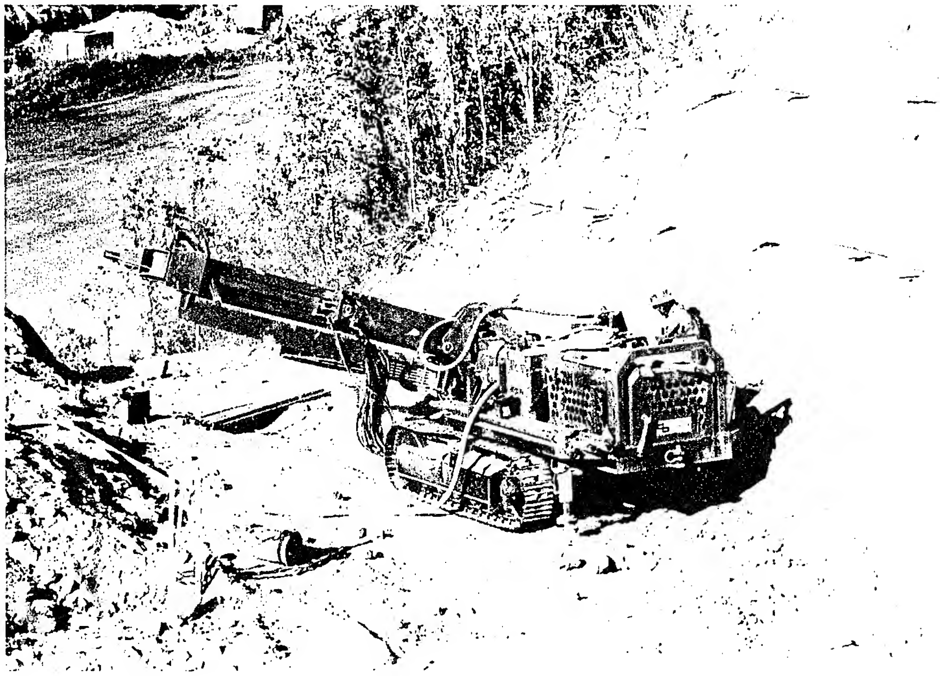


PHOTO E13. Craelius rotary drill - drilling anchor holes at downstream portal.

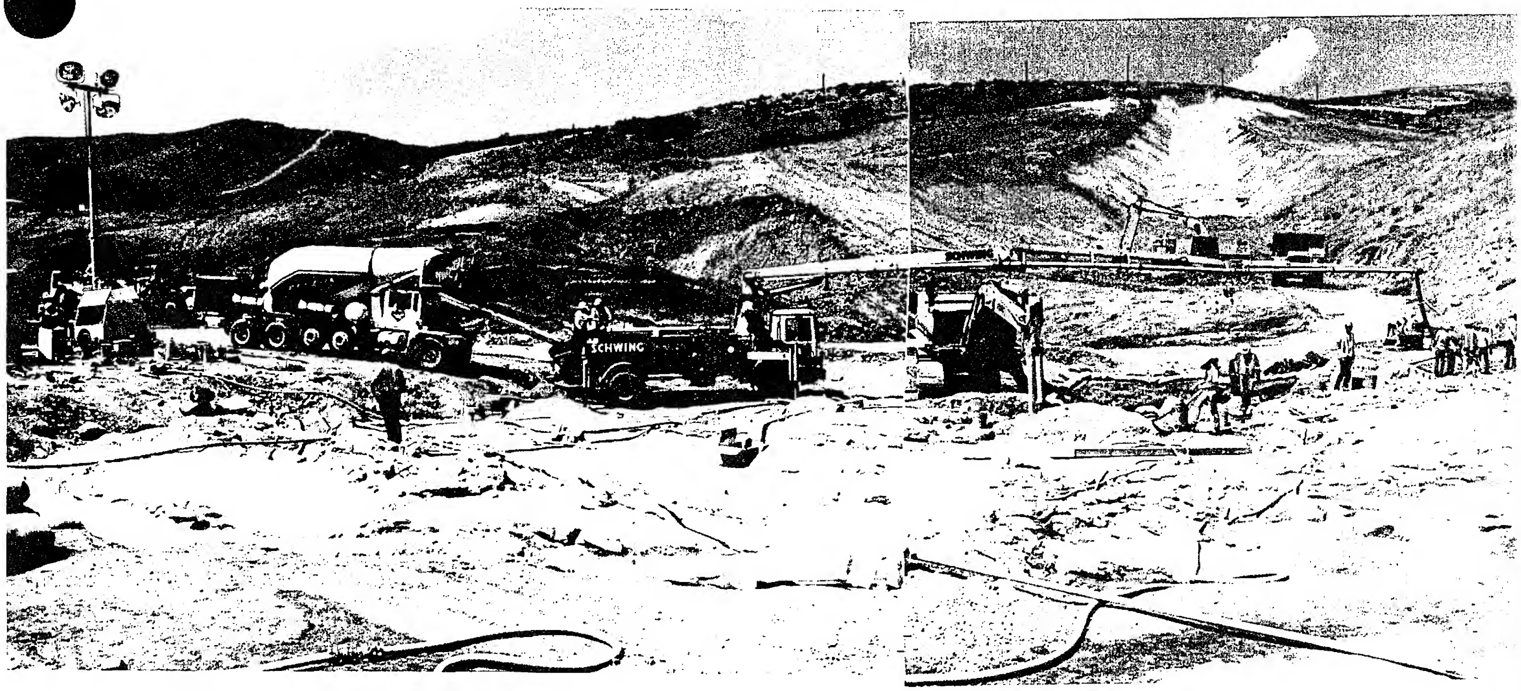


PHOTO E14. Concrete truck and concrete pump truck placing leveling concrete near Sta. 15+00, toe of upstream cutslope.

PHOTO E15. Same as previous photo.

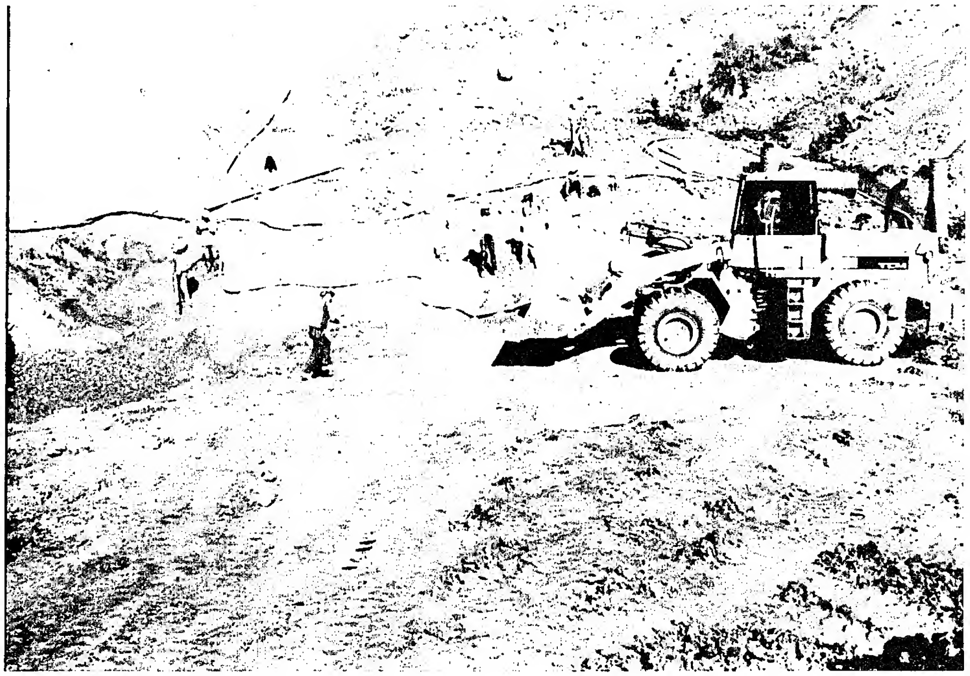


PHOTO E16. Mesco 870 front end loader wheel rolling impervious core against core trench abutment. Photo looks at right abutment approximate Sta. 22+50. Front edge of bucket is near centerline.

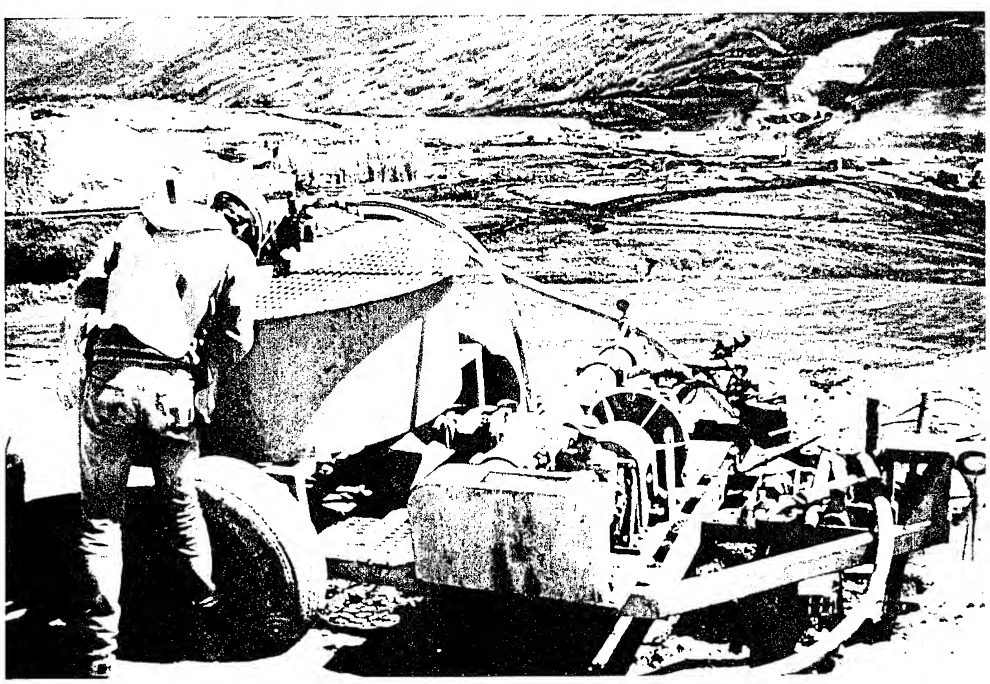


PHOTO E17. Boyles Bros. shop frabricated agitating tank/transfer tub.

PHOTO CC1 (Cut-and-Cover). Outlet Works Intake area. Cat 235 trackhoe excavating organic overburden and loading a Cat 631C scraper.

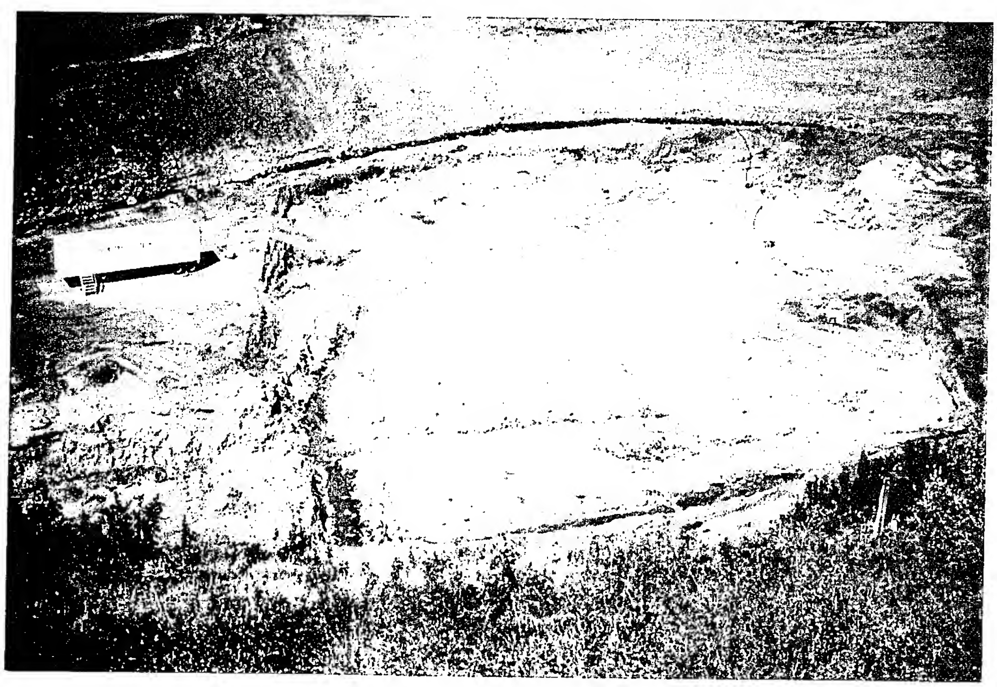


PHOTO CC2. Outlet Works intake area, looking upstream from the portal area at the foundation for the engineered fill under the intake structure and the cut-and-cover conduit.

PHOTO CC3. Constructing a drain to de-water at the cut-and-cover conduit foundation. A 12-inch diameter perforated pipe was covered with boulders and cobbles then chinked with smaller rock.

PHOTO CC4. View of the foundation for engineered fill under the downstream end of the Outlet Works cut-and-cover conduit. Photo looks downstream toward the upstream portal.

PHOTO Q1 (Quarry). Quarry at Peoa, Utah. Looking northeast at face being worked in Nugget Sandstone.